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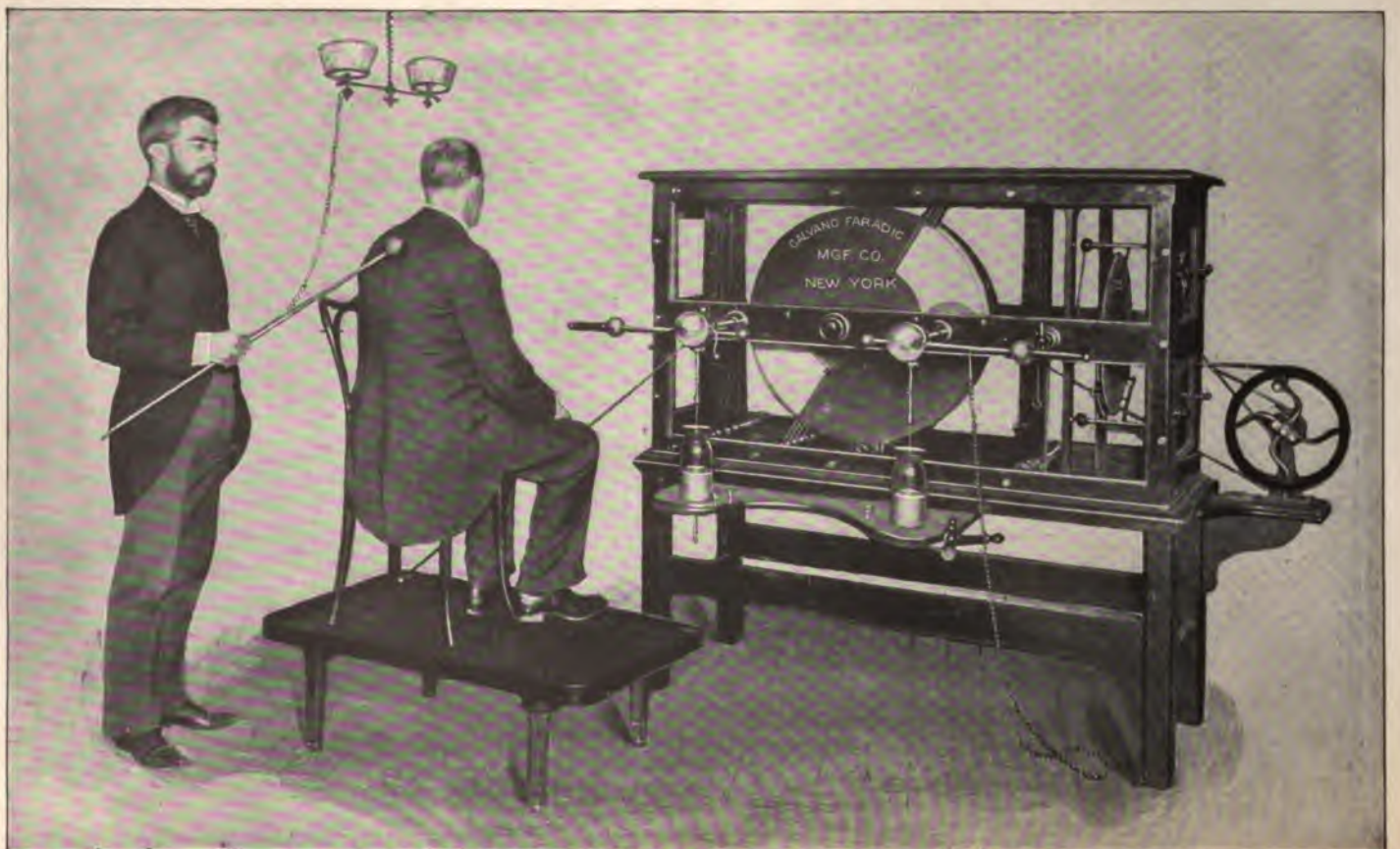
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MANUAL OF

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S. H. MONELL, M.D.

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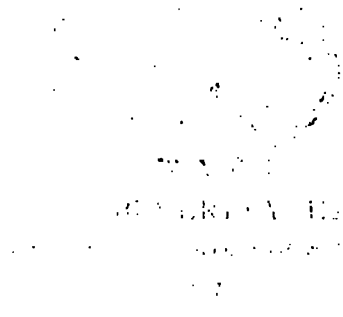

MANUAL OF

STATIC ELECTRICITY

IN

X-Ray and Therapeutic Uses

LANE LIBRARY

BY

S. H. MONELL, M.D.

Founder and Chief Instructor of the Brooklyn Post-Graduate School of Clinical Electro-Therapeutics and Roentgen Photography; Fellow of the New York Academy of Medicine; Member of the New York County Medical Society, Kings County Medical Society, and New York Electrical Society; Editor of the Electro-Therapeutic Department of the *Medical Times and Register*; Author of "The Treatment of Disease by Electric Currents, a Handbook of Plain Instructions for the General Practitioner."

ILLUSTRATED

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PREFACE.

MEDICAL electricity has three great subdivisions, Static, Galvanic, and Faradic. The demonstration that the static machine affords the best means of exciting X rays within a Crookes tube gives it now an extraordinary interest to the physician and surgeon, and places it in the front rank of high potential apparatus.

In this volume the author aims to present in a concise and intelligible form the essential facts relating to static electricity and its successful application to the treatment of disease.

It will describe how to care for and operate the best type of modern static machine, and will set forth as clearly as possible therapeutic indications for the various methods of administering the currents which it produces. Lengthy descriptions of obsolete apparatus are entirely omitted in favor of the fullest practical account of clinical details.

The chapter upon X-ray methods describes in full the necessary static technique.

The therapeutic section of the book presents the clinical experience of the author and others and describes methods of treatment with painstaking exactness.

The static machine is now to be found in the offices of many physicians both in large and in smaller cities, and its use is not alone confined to special practitioners and institutions. The X ray is spreading it rapidly. As it has become better known it is more frequently employed, and each improvement in its construction has marked a new step toward a popular career.

In spite of its antiquity as a medical apparatus, it is but on the threshold of its real introduction to the profession at large. Those who have used it successfully during the past decade have rejoiced greatly at the advantages it has given them, but little or no effort has been made to develop its literature and spread abroad the knowledge of its usefulness.

On the contrary, it has been subjected to partisan and unreasonable criticism which has influenced many to question its practical value, and writings upon the subject have been exceedingly meagre.

The demand for a work of this character has been urged upon me by many who have sought in vain the desired facts in any single publication, and I have been persuaded by those who have read my various contributions to medical journals to undertake the task of placing before the profession a practical treatise upon static electricity.

The galvanic and faradic currents have been quite extensively written upon, and they not only furnish the chief theme of electro-therapeutic articles in the journals of the day but a considerable number of volumes describe their properties and uses. Various text-books upon materia medica and therapeutics also mention their action and accord them some space. Scarcely any such service has hitherto been performed for static electricity, and the disproportion between its worth as a curative agent and the extent of its literature is a remarkable anomaly.

It occupies a field peculiarly its own, in which it is unique. It is an ally rather than a competitor of other currents, and it constitutes another link in our chain of resources. No argument is needed now to support the right of static electricity to equal consideration and rank with methods in general use. Electricity is not hostile to any other mode of cure. All that electricity, and drugs, and massage, and heat, and cold, and hydrotherapy, and climate, foods, mental therapeutics, and surgery combined can do for suffering humanity is yet utterly inadequate to supply the demand for relief from pain and disease. The united forces of medicine need more help and not less. With this fact in view the author commends the fuller study of static electricity to the profession at large.

S. H. MONELL.

865 UNION STREET BROOKLYN, N. Y.
March 11th, 1897.

AUTHOR'S NOTE TO THE SECOND EDITION.

THAT the first modest edition of this manual requires to be supplemented by a second within three months of the original publication is peculiarly gratifying to the author.

For the kindly reception accorded my book by the medical profession and the medical press I feel a sense of very grateful appreciation. The verdict of the critics upon a treatise which was the first of its kind yet published in any language, and which dealt with a subject unfamiliar to the majority, could not be foreseen. The verdict has been universally favorable. For the fairness and uniform interest with which my statements and teachings have been discussed, I take this opportunity to express my thanks.

Many who employ no electrical apparatus themselves have found it useful to become acquainted with the actions of a remedy about which they before knew little. Moreover, every physician now desires the facts which my book gives about X-rays.

Among the numerous evidences of the favor with which my work has been received, none are more agreeable than letters which come to me from readers stating that I have made my directions *plain* and satisfactory. However pleasant it may be to receive flattering comments upon other merits of the book, and its importance as a contribution to progressive therapeutics, it is particularly gratifying to know that both the clinical and X-ray directions, which I sought to make clear and explicit, are plainly understood by all who read them.

S. H. M.

JULY 2d, 1897.

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PART I.

"It should ever be borne in mind that the best instrument does the best work under the guidance of the best hand."

STATIC ELECTRICITY.

CHAPTER I.

THE HOLTZ APPARATUS.

Its permanency in therapeutics. Explanation of former dissatisfaction.

STATIC electricity was given to medicine about the year 1750. It was brought to America by Benjamin Franklin about 1752. The modern Holtz induction machine, the representative source of static electricity to-day, is now made in two therapeutic sizes. The six-plate, twenty-six or twenty-eight-inch machine is the smallest that is effective. The eight-plate, thirty-inch machine is more powerful and impressive. The difference in cost is about fifteen per cent.

In view of the fact that it presents at once a therapeutic appliance of high efficiency, and the best electrical means of exciting a vacuum tube for Roentgen X-ray effects, the Holtz machine can no longer be deemed an expensive luxury. It has become in a single year a reliable, easily operated, moderate-priced necessity; and the author's former prediction of widespread recognition for this apparatus, once nearly abandoned, is in process of gradual and complete fulfilment. With a one-sixth horse-power electric motor, a water or gas engine, or by hand, the physician instructed in its technique can operate it successfully every day in the year. It is no longer a creature of atmospheric variability. Its earlier drawbacks have been overcome. It is now as satisfactory a part of the practitioner's electro-medical equipment as are the chemical cell and the induction coil.

No detailed description of the improved Holtz apparatus is required, for its general appearance is familiar, and the frontispiece illustrates it completely.

It is a common mistake to suppose that medical electricity is still in its infant and experimental stage. The three great currents employed in medicine date from about the years 1832, 1800, and 1750. They have been tried in the clinical balance, tested in laboratories, and proved by experience. Ninety per cent of the practical uses of these currents has been fully established and determined by the teachings of electro-physiology. Static electricity is new to-day only in the sense that the multiplication table is new to every schoolboy who learns about it for the first time.

Almost every disease successfully treated by many physicians by this agent in 1896 was successfully treated by it by a few men a century ago. Methods, electrodes, and principles involved are practically the same, with the exception of Leyden-jar currents and the substitution of induction for friction by Holtz in 1865. Apparatus reached nearly its modernized form in 1885. Workmanship has gradually improved it, but the latest apparatus has now been manufactured for over three years. The last method to be introduced to static therapeutics was described by the present author in 1893. Static electro-therapeutics in expert hands has been substantially matured. "Rapid advances"(?) or further discoveries cannot impair the great value of ninety-nine per cent of the practical work of the Holtz machine. The improvement now going on consists chiefly in the increase of knowledge among individuals who were before ignorant of this branch of medicine.

The great development of the decade 1885–95 placed static electro-therapeutics upon a firm and advanced basis. Its efficiency in producing X rays puts a fitting climax upon the achievements of the Holtz machine.

A comparatively large number of physicians have, during the past fifteen years, bought static machines of some kind. Many

of these were never large enough for clinical use, and even in recent years, when the best type of apparatus has been more generally purchased, the majority of operators are still self-taught. Their knowledge of operative technique has been gathered from scattered reading, and with difficulty. We cannot set a high value upon "picked-up" knowledge of how to employ this machine, for it demands a rarely exhibited degree of manual skill and trained judgment for its most effective use; but object lessons in my clinic have led me to believe that the practitioner who is not instructed in proper methods by a competent teacher or by long experience is very heavily handicapped in struggling for results.

If there are, as I have seen stated, over three thousand large and small machines of all kinds in this country, it has been asserted that not more than one per cent of the owners are skilled manipulaters of the apparatus they possess, but owing to the new impulse given to appreciation of the static machine by reason of its superiority for X-ray work, it is likely that many of the older and perhaps discarded apparatus will be got out again, furbished up, a small Wimshurst charger procured if the device is not self-charging, and fresh interest taken by the owners in the valuable remedy they have neglected.

Satisfactory clinical employment and the best X-ray effects both require that the operator shall possess the skill to discover defects and correct them, manipulate accessory devices, have ready resource when one effort fails, and override with ease difficulties that would hopelessly embarrass the tyro in electrophysics. While therapeutic attempts to use the static machine often failed to impress this lesson upon the medical mind in the past, yet the Crookes tube will do so at once, for if it is not adroitly handled, and its ever-varying vacuum coaxed by requisite arts to the height of excitability, the fluoroscope may not reveal the diagnosis the physician seeks to make. It is an old saying that knowledge is power, and it is especially true of the static machine that knowledge of how to operate it

successfully is the foundation on which clinical victories are built.

A point too commonly lost sight of in weighing criticisms of electricity as a therapeutic agent is that the apparatus which produces the current is not the current itself. Many of the earlier criticisms that applied to static electricity in the days of frictional machines (prior to 1865) are therefore obviously inappropriate to the product of newer, larger, and more powerful induction machines giving vastly superior therapeutic currents.

A physician unfamiliar with static electricity, but familiar with statements by well-known authors declaring "static electricity a failure," would be amazed to witness the performance of a splendidly handled and powerful Holtz machine. The strictures perpetuated in some general medical writings would seem irreconcilable with the evidence of his eyes; but however incredible he might regard them in the presence of a superbly powerful apparatus, they become perfectly credible if we apply them to an inferior machine acting under unfavorable conditions.

The static machine must therefore be considered on the individual merits of itself and operator, as distinguished from static electricity in the abstract. No cripple is more helpless than such a machine without its electrical charge. It is absolutely useless. It is more aggravating than an inert preparation of ergot or an insoluble cathartic pill. It is like an empty rifle. Without a proper charge the rifle and the Holtz machine are equally inoperative, and both equally require a directing skill in order to achieve results.

It was the lack of a self-charging device, more than all other causes combined, that delayed the general employment of Holtz machines. For a century and a half the frictional apparatus remained unsatisfactory, but since about 1885 we have had the induction type of satisfactory power provided it remained charged. When it discharged in unfavorable weather it was often so difficult to recharge that few could endure the annoyance without

complaint. The means employed to restore the lost charge was usually the friction of a piece of catskin upon the revolving plates. Any one who has tried this on a damp day in summer needs no further explanation why static electricity was "abandoned by experts." The pivotal improvement for which confidence in static electricity so long waited was a ready means to charge the static machine. This necessary improvement was finally made in 1893 and is since incorporated in all modern Holtz machines.

That there may be just ground of complaint against some static machines even now, must be apparent when we consider that many of those in the hands of physicians are either old, or have too few and too small plates, or have got out of order from neglect. A certain amount of care is required to keep any piece of machinery in proper working condition. If a static apparatus is allowed to stand neglected and exposed to atmospheric changes, invaded by its twin enemies dust and damp, its bright parts tarnished and corroded, its wood parts warped, its electrodes, conductors, and platform covered with a film of dust, its internal adjustment deranged, and operated, if at all, by an indifferent assistant without either mechanical aptitude or special experience, no one should wonder if the results are disappointing.

It sometimes also happens that poor results are obtained under apparently excellent conditions, or conditions which a non-expert could not readily believe to be unfavorable. A case in point may be cited, to illustrate the importance of understanding the facts before shifting the blame from the operator and the machine to static electricity itself. A prominent specialist in electro-therapeutics, after twenty years' experience with galvanic and faradic batteries, procured a Holtz machine It happened to be in the early summer when it was placed in his office. During the summer it gradually gave out a feebler and feebler current, was discharged nearly every day, rattled when revolved, its combs scraped against the plates, and it was

generally disappointing to its very able owner. As the physician in question had never had any thorough instruction in the care and management of the machine, he could see no reason why it failed to work. An expert examination, however, at once disclosed the facts.

This physician habitually kept his office windows open throughout the summer, regardless of fog, mist, or rain. The chloride of calcium in the case was saturated with moisture and had been damp when it was first put in. The poles were left in close proximity, and the machine usually discharged itself every night. On this account he had opened the end doors every day with windows still open, rain or shine, while he laid siege to the inner plates with the tedious and uncertain catskin. When in operation, the machine was so situated that the platform was almost directly under the prime conductors, and the outer edge of it was separated but a few inches from his office desk.

These conditions were all bad, yet to a general observer it would seem incredible that, in so fine an office and in the hands of a renowned medical electrician, a new and superior static machine could behave so poorly. Skilful as the doctor was in his familiar work, he had made no attempt to prepare himself by instruction to skilfully manage the new apparatus he had purchased, and such a state of affairs has no doubt furnished the ground for many adverse criticisms against static electricity. However, the combs were set right, the chloride baked dry in the oven, the various parts cleaned and adjusted, and the machine was then recharged. Directions were given to keep the doors of the case tightly closed, the poles separated, and the groundings taken off when not in use, and the external parts kept free from dust and damp. It is needless to say that a great improvement took place in the performance of this machine. Had the apparatus been furnished with the miniature charger now supplied, and had the doctor but taken ordinary care to keep the case dry, he could have used his machine

every day in the year with very little trouble and very great satisfaction.

Other instances of a similar nature come before me every year. No machinist would expect to operate a peculiar engine unless he was first taught how, and yet the majority of physicians fail to regard the source of the static current as a mechanical appliance requiring mechanical knowledge to operate satisfactorily.

CHAPTER II.

COLLECTED OPINIONS AS TO THE VALUE OF STATIC ELECTRICITY IN MEDICINE.

It is natural for a physician to ask why mention of static electricity is so nearly absent from all general text-books upon the practice of medicine and surgery, if it possesses the properties that are claimed for it.

The answer to this question is no doubt to be sought in more directions than one. The long neglect of mechanical ingenuity so to improve the apparatus that it would readily work under all circumstances was a bar to its general use. Moreover, little has been done until recently to make known to the great body of physicians the place it justly fills in therapeutics. Scarcely a college, hospital, or dispensary in the United States has possessed a reliable static machine and taught its clinical applications to disease. Teachers and text-books have alike ignored it almost completely. There is not a single modern book devoted exclusively to this subject to be found in print to-day.

I am, however, convinced that the extraordinary properties of frictional electricity would have obtained a widespread recognition from medical teachers had inventive skill and enterprise not long slumbered over the machine that generated it. No single drug, and no other form of electrical current, received equal attention from the earliest and greatest of experimental philosophers. During half a century it occupied alone the whole field of electro-therapeutics. But the crude types of apparatus were too imperfect for ordinary use, and no one improved them. Then static electricity fell into neglect, became chiefly a laboratory wonder, astonished admiring students by its disruptive discharge and accompanying phenomena, but played a small part in relieving the sufferings of humanity. Something has been done, however, in a few instances and at wide

intervals of time, to demonstrate the value of this therapeutic agent; but the reports of the results have been so ignored by general medical literature, and have been given so little modern currency among physicians, that they contribute practically nothing toward enlightening the profession. I presume that not more than a dozen physicians now living have read the full reports of Addison, Bird, and Gull. Letters continually coming to me indicate that physicians in general do not know where to obtain literature upon static electricity, and it is for this reason that this work has been undertaken by the author.

In many cases, where another current may be commonly used, static will be preferred by all at whose command it is, for two reasons: (1) It is often more easily applied; (2) it is often more speedily effective. Some of its work is done with astounding facility; so much so as to lead to over-confidence in its powers. When it has failed, it has been correspondingly over-abused; so that half the profession do not know what value to attach to it. These contradictions and disputes about it are scattered through medical text-books, and the reader who consults his library alone to find out the therapeutic worth of static electricity has a perplexing task before him.

For the purpose, therefore, of untangling the maze of conflicting and bewildering statements that serve to confuse this subject, I gathered together in 1894 a number of extracts taken from various sources, and shall present them here again in such a manner that every physician who reads this chapter can form a competent judgment for himself. As has been said before, the literature of static electricity is exceedingly meagre, but medical writings have been ransacked by me to obtain both sides of the case. No attempt at chronological order has been made, but the authority for each extract will be fully given, and can be verified.

Quain's "Dictionary of Medicine," 1888, article on "Electricity," by G. V. Poore, eight and one-half columns in length, dismisses static electricity in thirty-six words, as follows:

Franklinic electricity, which is generated by the friction of glass discs or cylinders, which was formerly in vogue, has now become nearly obsolete in therapeutics and need not detain us in an article like the present.

"Electro-Therapeutics," by Wilhelm Erb, M.D., 1887, is a volume of 726 pages and about 275,000 words. It contains but three brief references to static electricity:

1. The invention of the frictional machine facilitated the use of this agent, yet, though largely employed, we do not see that the results amounted to much.

2. Many attempts have been made, and at various periods, to utilize frictional or static electricity in therapeutics, but they have (even those most recently made in Paris) not had such results as to secure for static electricity a certain position in this connection. We need not therefore speak of this form of electricity, which, moreover, obeys the same fundamental laws which govern the other forms.

3. Static electricity has been employed in Paris, not without effect (Charcot, Vigouroux), for all hysterical symptoms as well as for the actual disease itself.

The last of these is printed as a footnote, and the balance of this great work is devoted to galvanism and faradism. The immense disproportion between the space accorded these and the brief references to static illustrates the extreme oblivion to which the latter has been relegated by prominent authors. Duchenne, who has been entitled the father of modern electro-therapeutics, affirms that:

Static electricity affects neither the internal organs, nor the pulse, nor the secretions, nor the intellectual functions, nor the respiration; and that it is to-day abandoned, its therapeutic value being as little appreciable as its physiological action.

In the two large and learned volumes on "Localized Electrification," Duchenne devotes scarcely four pages to static electricity, but Arthuis ingeniously remarks upon this "that, as every word is an error, he has done well to be so reserved." Nevertheless, Duchenne says further along:

It is assuredly incontestable that static electricity, which for so many years was used exclusively in practical medicine, has accom-

plished cures bordering on the marvellous. Static electricity has cured chorea and a large number of nervous and paralytic affections.

Dr. Tripier says, in his "Manual of Electro-Therapy," 1861:

Static electricity offers resources too much neglected in our day. There is in it, in the electric bath, the electrification by needles, the souffle, that which cannot be supplied by any equivalent procedure, and before being banished from therapeutics an experimental study should be again entered into to learn its effects.

In 1850 Dr. Wilks writes in the Guy's Hospital reports this observation from his experience:

After the introduction of electro-magnetism, or faradism, static electricity fell into disuse, but I feel confident that it was not successfully superseded by the new agent.

The authorities for the succeeding group of extracts are given in each instance:

The modified Holtz, or Toepler-Holtz, electrical machine is now used to procure all of the nerve and muscular effects hitherto obtained by faradic electricity, and also therapeutical results of a very striking kind.—*Bartholow's "Materia Medica,"* 1890, p. 430.

For many years after the discoveries of Galvani and Volta static electricity still remained in exclusive possession of the field of electro-therapeutics. The number of accessories required, the expense and cumbersomeness of the machines, and the unpleasant shocks employed as its chief mode of administration have prevented its frequent use in the treatment of disease; but no electrical department of a hospital would be complete unless it were provided with an apparatus for the treatment of patients by statical electricity.—*"Medical Electricity," by Steavenson and Jones,* 1892, p. 86.

Considered from every standpoint, a successfully operated and powerful static machine is, without doubt, the most surprising single therapeutic weapon in the whole arsenal of scientific medicine. —*"A Brief Synopsis of the Therapeutics of Static Electricity," by S. H. Monell, M.D. New York Medical Journal,* January 20th, 1894.

There are many pathological conditions in which frictional electricity is to be preferred to the other modifications.—*Wells' "Electrotherapy,"* 1869, p. 159.

It will be observed that little mention is made of static electricity. This is because its use is practically debarred the general practitioner by the expense of the machines and difficulty of managing them, and because its use in my own hands has not been followed by better results than that of faradism, which is simpler of

application and accessible.—"*Practical Electro-Therapeutics*," *by W. F. Hutchinson, A.M., M.D.*, 1888, *Preface*.

The static spark was even less useful—in fact, I have of late discarded it as a pain-killer, believing that in a majority of cases, no matter how skilfully handled, it is as apt to aggravate as to relieve. —"*Electrical Anæsthesia*," *by Dr. W. F. Hutchinson*, 1892, p. 12.

In this agent we possess one of the greatest stimulants to metabolism. It is doubtful whether either of the other forms of this force can compare with static electricity as a metabolite. Without doubt static electricity is the ideal cutaneous stimulant.—*Plym. S. Hayes, M.D.*, "*Electricity in Diseases of the Skin*." "*Int. System of E. T.*," 1894, p. H. 11.

Static electricity often gives successful results in the treatment of motor as well as sensory symptoms. Of late years this variety has been much used, and in a great measure has superseded the galvanic and faradic currents in the treatment of neuroses, largely because of the convenience with which it can be applied, and its adaptability to a variety of different conditions.—"*Neuroses*," *by Morton Prince, M.D.* "*Int. System of E. T.*," p. K. 40.

A form of electricity still higher in tension and lower in quantity than the faradic current is the static or franklinic electricity. This, after having almost fallen into oblivion, has recently been resuscitated as an agent of great value.—"*Electricity in Diseases of Childhood*," *by Mary Putnam Jacobi, M.D.* "*Int. System of E. T.*," 1894, p. Q. 25.

The *Medical Record*, April 6th, 1889, reports a discussion on "the place of electricity in therapeutics," at the Academy of Medicine, March 21st, 1889, in which Dr. M. Allen Starr said:

It seems strange how much credence was still given static electricity in therapeutics, for its action was limited exclusively to the surface of the body charged; it did not penetrate the skin, could not permanently charge the body, and could produce a curative effect only as a surface irritant, or by reflex action, which effect could be obtained equally well by faradism or by massage, lomi-lomi, whipping by twigs, etc.

Dr. Starr closed with the following statements:

Static electricity offered nothing more than the interrupted galvanic, and failed to furnish those effects which were most desirable in the treatment of disease. . . .

Dr. L. C. Gray said:

He had no faith in static electricity. The two currents which

would answer every purpose of the physician were the galvanic and faradic.

Dr. E. D. Fisher said:

Undoubtedly galvanism was more important as a remedial agent in nervous functional diseases than was static or faradic electricity; yet in regard to static he would say that in his opinion it should not be so positively discarded as it had been by Dr. Starr. Especially in neurasthenic cases did it have a stimulating and pleasing effect. It was in functional diseases, with error in nutrition, and not organic troubles that static electricity found its field of usefulness.

Dr. A. H. Smith

. . . had obtained marked and immediate benefit from static electricity, as he could do from no other form in soreness and stiffness of the wrists and other joints, due to exposure to cold.

A convincing reply to Dr. Starr's paper appeared in the *Medical Record*, May 31st, 1890. In it the author says:

He was struck by its merits and efficiency as exhibited at Professor Charcot's clinic in Paris in 1880; . . . the therapeutic use of static electricity has extended enormously in medical practice. . . . Dr. Starr's entire structure based upon the static charge falls to the ground. . . . I believe that no form of electricity penetrates more deeply than the static; and premising a powerful machine, a powerful spark, a conservative expectation as to results, a fair comparison with galvanism and faradism, an intelligent selection of cases, and a fair amount of skill in administration, I believe that no other form of electricity equals it in curative effects.

The following extracts are taken from the Guy's Hospital reports of the years given below:

As a last resource I determined upon giving [static] electricity a fair trial. The effect produced by it at once gratified and surprised me and led to further trial, the results and particulars of which will not, I trust, be deemed altogether unworthy of the profession. Certain it is that although I had often ordered it myself and more frequently witnessed its employment by others, I never for a moment entertained the belief that it possessed the power over the disorders alluded to that I am now inclined to concede to it.—*Dr. Addison*, 1837.

So many discrepant statements exist in the records of medicine regarding the action of [static] electricity, as an agent in the treatment of disease, that scarcely any general opinion can be drawn

regarding its real influence. In the hands of some it has appeared to possess an almost magical action in the most intractable diseases, while others equally worthy of confidence have declared it to be utterly worthless. [After describing the manner in which case records were kept in the electrical room under his own supervision, and reporting the results in about one hundred cases, Dr. Bird goes on to say:] In the remarks contained in this paper and from the cases detailed, I venture to hope that I have adduced a sufficient amount of evidence to demonstrate that [static] electricity, though possessing no specific or magic influence over any particular disease or class of diseases, is yet really capable, when judiciously applied, of producing marked effects; and although it fails to produce the wonderful results ascribed to it by empirics, is nevertheless capable of becoming an important aid in the treatment of disease.—*Golding Bird, A.M., M.D., F.L.S., etc.*, 1841.

The effects of [static] electricity in chorea are sometimes very remarkable. On some occasions I have known it to effect a cure after a great variety of other remedies had for weeks and months been tried in vain. When the body has been wasting, the mind apparently giving way, and the disease proceeding unchecked if not increasing, notwithstanding a variety of remedies employed assiduously and for a long time, electricity has under my own observation and direction effected a really marvellous change. The disease has in fact been cured and the effects of the disease upon the health and appearance have ceased. When electricity acts beneficially in chorea it produces its effects more rapidly than any other remedy with which I am acquainted, but it is a remedy which is not of universal application in chorea.—*H. M. Hughes, M.D.*, 1846.

The remarkable and in some instances astonishing results obtained by [static] electricity in chorea would seem to warrant the assumption of some direct controlling power in the electrical force over the nervous system, but these are probably in part explicable by the known action of this stimulus upon the tissues. . . . It is in hemiplegia and paraplegia, depending upon the direct influence of cold or arising from atony and hysteria, that [static] electricity is of the greatest value. In these cases it is inestimable.—*William Gull, M.D.*, 1853.

The above but faintly represents the sound observations and extensive clinical records made by these members of Guy's Hospital staff, but lack of space prevents any longer extracts from this interesting source.

To my mind too little importance and too small space is given to the consideration of static electricity and too little is said of its

value as a curative agent. It is with a growing conviction of its worth as a therapeutic agent, and its right to equality of rank with the other currents, that I seek to bring it more prominently before you.—"*Static Electricity as a Therapeutic Agent*," *by F. E. Caldwell, M.D. Journal of Electro-Therapeutics*, 1893.

I have been struck in many instances with the rapidity with which it effected an apparent cure, in other cases with the permanency of its beneficial results, and in all with the simplicity and ease of its application. To a lady, for example, it is a matter of no small moment that she is free from the necessity of divesting herself of any garments worn, and almost any part of the body can be treated without exposure and annoyance. To the busy practitioner also to whom time is valuable, it is not unimportant that no delays are caused by waiting for each patient to remove and replace their clothing. As a curative agent I regard static electricity as of great value. Static electricity is to-day, for the second time, generally recognized by the profession as a valuable therapeutic agent. It is steadily regaining the popularity it so justly achieved in the eighteenth century.—"*Static Electricity in Medicine*," *by A. L. Ranney, M.D. The Physician and Surgeon*, 1887.

I will next quote from three different editorials in the *Journal of Electro-Therapeutics* for different years:

1. In examining the reports of static electricity and its action upon diseased conditions, I have been unable to find any person who possesses one of the later improved machines, capable of producing a good volume of electricity amid all the changes of the atmosphere, but that believes that it has a special sphere of action which is possessed by no other agent known to him. . . . That static electricity affects such deep parts of the body as the interior of large joints, the ovaries, and deep-seated muscles, when diseased, thousands of cases on record from good and reliable observers prove to be a fact. As regards the objection that it is not capable of producing any effects that the galvanic and faradic currents are not, we might theorize extensively here to prove that it differs from either of the other forms of electricity; but as practical results are always better than theory, we will say that we could, if time permitted, report a few cases which had thorough trials of both galvanic and faradic electricity without effect, and which were cured with a very few applications of static electricity. The reports of hundreds of cases, by physicians all over the world, entirely coincide with this view.—*April*, 1890.

2. We have been very much surprised to find that there are so many static machines in use. . . . When we come to consider the

question of static electricity fairly, I think we must conclude that it holds an important place in electro-therapeutics, the exact position of which is not quite so well understood as are the galvanic and faradic currents, and therefore needs all the more to be carefully studied, observations carefully recorded, and unprejudiced writers to put it before the profession.—*July*, 1893.

3. In conclusion, I would say that my honest conviction is, after treating a large number of cases with electricity, that the static form is of far greater value than faradism, and at least as useful, if not more so, than galvanism.—*July*, 1894.

These statements bear evidence of careful consideration, and the four years covered by the dates of publication seem to have only convinced the author more and more of the merits of static electricity. Our next extract recalls the manner of Erb and Poore:

The chief interest in electro-therapeutics has heretofore centred about the galvanic and faradic currents, although the value of the static current in cases adapted to its use is unquestioned. I have made much use of the last-named current during the last ten or twelve years, but consider its value so small and its application so limited, when compared with the indispensable utility of the galvanic and induced currents, that I shall devote no space to its consideration.—"*A Discussion of the Electro-Therapeutic Methods of Apostoli and Others*," *by J. H. Kellogg, M.D.* "*Int. System of E. T.*," 1894, p. G. 54.

The next quotations are from a different source:

. . . it is not my purpose to enter into any discussion of the limitations to or the indications for the use of faradism, of galvanism, or of static electricity. I have used all of them, but have been disappointed in the results obtained from the latter. In this I know I shall not be supported by many who are present. But here again *a priori* considerations may have swayed me into not using it often, and also the fact that the test cases in which I applied it were the contractures secondary in hemiplegia, where faithful applications during several weeks made no change whatever.—"*The Sphere of Usefulness of Electricity in Nervous Diseases*," *by Joseph T. O'Connor, M.D., Ph.D. Journal of Electro-Therapeutics, December*, 1893.

I have made use of static induction in ovarian pain, neuralgic, or even due to cystic ovaries, prolapsed ovaries, or salpingitis, and I have never had it fail to give surcease from suffering. . . . We are just enough emerged from primitive darkness to realize that

static electricity will eventually play a leading rôle in therapeutics. . . . I know of but few diseases in which static electricity may not be used. As a gynecological electro-therapeutist I owe it much, for there be complications and anomalous conundrums that try the patience, and static electricity is balm to the irritated soul.—"*Static Electricity as a Therapeutic Agent*," *by Horatio R. Bigelow, M.D.*, 1893.

Adams states that in all vasomotor disturbances, functional cerebro-spinal diseases, or neuroses, there is nothing in the author's experience which equals in value the diffuse and the concentrated constant high-potential current from electro-static induction machines.—"*Materia Medica and Therapeutics*," *Shoemaker*, 1893, vol. i., p. 145.

I regard static electricity as a most valuable addition to our armamentarium. No one who expects to meet the demands of all the varying idiosyncrasies of the nervous system can afford to be deficient in the completeness of his electrical outfit. Static electrification possesses nutritive and tonic properties of a high order, and in certain conditions one may even succeed in obtaining results after unsuccessful attempts with dynamic electricity.

Ideas will of course differ as to which of the various manifestations of electricity are the most efficient therapeutically, according to the character and extent of one's experience. After many years of observation and comparative trial, my own judgment is that the dynamic forms of electricity, properly utilized (and I emphasize this point because far more care and detail are called for than in the use of static electricity), occupy a wider field of therapeutic usefulness than the static form; but each form has its special uses and adaptations, and all are indispensable to him who makes much use of electricity in medicine.—*A. D. Rockwell, M.D., Letter to Author*, February 15th, 1895.

How shall these conflicting statements be reconciled? For unless it can be shown that one side or the other is worthy of our confidence we can form no true opinion of the merits of the case. Static electricity has been long enough in use to test and ascertain its therapeutic action. It has been before the profession longer than the iodides, bromides, cod-liver oil, and other remedies now well known. In fact it antedates scientific pharmacy altogether. Although the early machines were inferior to modern ones, yet static electricity did active service in a few hands upward of five generations ago. It flourished to a

great height of prosperity for fifty years, relapsed into a singular oblivion, again emerged from it, slowly advanced into limited favor, and finds its brilliant reputation of a past century now obscured by a maze of contradictory literature so confusing to the reader that it requires something of an expert to perceive the truth. In grouping these opposite views together one noticeable fact is made clear, viz., that the advocates of static speak from a large personal experience with it, while those who denounce it have generally had little or none whatever. Let us now glance over the unfavorable assertions we have cited, and mark "how plain a tale shall put them down." It will be found that no argument on my part will be necessary, for, singular to relate, they all fall to pieces at the slightest touch, like a house of cards.

G. V. Poore's comment refers to inferior and antiquated *friction* machines, which, in the damp climate of England, of which he writes, were operated at a great disadvantage. In the drier climate of the United States our modern and powerful *induction* (not merely frictional) machines are far more satisfactory; and as no drug would be condemned because an inferior preparation of it failed, so it is not reasonable to denounce a given form of a useful agent like electricity because a certain type of machine, which is now obsolete and was long ago superseded by a better one, did not produce a sufficient dose for general usage.

Professor Erb's remarks appear to be those of a man who sees through a glass darkly, and who evidently does not intend to see the light. His third statement refutes the preceding two, and all three are manifestly second-hand information; it being plainly apparent that this classic writer does not speak from personal knowledge based upon competent experience. He is therefore not a qualified witness.

Dr. Duchenne's assertions are, on their face, ridiculous, and can be so demonstrated by any physician who will test a personal application of static electricity for fifteen minutes. Moreover, he destroys his own case by his later admission that "it

performs cures bordering on the marvellous, and has cured chorea and a large number of nervous and paralytic affections."

Dr. W. F. Hutchinson is the next detractor. In the extract dated 1888 he relegates this form of electricity to the attic. In his 1892 paper he "discarded it as a pain-killer, as it was as apt to aggravate as to relieve." Poore, Erb, and Duchenne may be accused of being behind the age of our new machines, but here is a prominent American author, nearly up to date (1892), who also has a poor opinion of static. How shall we dispose of his assertions? By his own testimony! In a New York medical journal for November, 1892, Dr. Hutchinson himself described a new static machine of the Wimshurst type, which he had recently purchased, and among his approving statements I quote the following:

> The new machine has certainly done its part. In driving rain, with open windows close by, or in clear sunshine, it goes steadily about its work, and I have had no annoyance from dampness. It is worth knowing that the static electricity is no longer out of reach of any one who chooses to employ it, and that its use is now free from the annoyances that caused experts to abandon it.

This certainly disproves his previous derogatory remarks. Place also Dr. Hutchinson's 1888 statement by the side of Dr. A. L. Ranney's of 1887, and compare. We next reach Dr. Starr's somewhat celebrated proclamation that static electricity "acts only as a surface irritant, after the fashion of lomi-lomi, whipping with twigs," etc. This dictum was put into imperishable print six years ago, but it became obsolete almost as soon as printed, if the story told the writer is correct.

I am informed that shortly afterward Dr. Starr was invited to step upon a static platform by a brother physician, who had read the article, and who applied a few sparks to the doctor's biceps, triceps, quadriceps, etc. The sparks spoke for themselves, and the discussion ceased, as Dr. Starr gracefully said he "would take it all back." Dr. J. H. Kellogg's strictures come next. He also furnishes us the material to refute his first remarks.

Dr. J. H. Kellogg stated that he had employed a small machine for many years. Later he had obtained a larger one, which he had used with better results. He, however, did not formerly regard static electricity with much favor. Within a year or so he had had a powerful machine made for him with six plates of forty-five inches diameter, and he was now much better satisfied with static electricity. In fact he was pleased with it, and got four times as good results from it as formerly. He found its effects very marked. The excretion of CO_2 was increased during the static charge. He recognized the value of increasing the power of the current.—*Discussion on Static Machines at the Fourth Annual Meeting of the American Electro-Therapeutic Association*, September 27th, 1894. Reported in *Times and Register*.

Extract from a discussion of the treatment of neuralgia reported in the *Post-Graduate*, April, 1893:

A neuritis may be "pounded" by the static spark, or submitted to a powerful static induced current, and it will cease to ache for a certain length of time after the first treatment, and this interval gradually lengthens until relief is permanent. He knew of *no other method* which accomplished the same result. . . . He believed that neuralgia could ordinarily be cured in a much shorter time by this treatment than by the methods usually employed. While his remarks had been particularly directed to the consideration of *sciatica*, they applied equally well to all other forms of neuralgia and neuritis. He had seen no case of neuritis so sensitive that he would not treat it actively by static electricity. (Results of ten cases were here cited.)

Immediately following the extracts above disposed of, we find the brief mention of static by Dr. J. T. O'Connor. It is probable that the doctor would object to have his skill in the use of a static machine estimated by the evidence he here gives. If "*a priori considerations*" have swayed him "*not to use it*," how, then, can he be a competent judge of its effects? A hanger-on who would be swayed by "*a priori considerations*" into not testing the efficacy of a beefsteak would hardly be an authority on the value of beefsteak in certain cases.

We thus see that most of our unfavorable extracts are refuted by the men who wrote them. The extent to which this is true is not a little remarkable but, unfortunately, these erroneous

statements once turned loose in print pursue their devious way, and although they may be called back or contradicted by their authors, they cannot be altogether inoculated against doing more or less harm. Many will happen to read them who may never see the retractions, and they are quoted and repeated by other writers who have little appreciation of the facts.* These refuted extracts which I have gathered together here, to illustrate the influence of the press against static electricity, are the irresponsible flotsam and jetsam of static literature. They float about among medical writings to unsettle the judgment of the inquiring reader, who, in search of truth, encounters instead these fallacious and abandoned fragments, which now, like derelicts at sea, should be run down and sunk into oblivion forever. Roentgen's discovery has done more to clear away the mists obscuring appreciation of the static machine than all the arguments of a decade.

* An instance of this character came to my notice almost as the above words were written. An article designed for publication in a medical journal was sent to me for my editorial approval, with a note in which the writer stated that it was "the result of his readings." In the opening paragraph he narrates that "static electricity expends itself mostly on the surface of the body and does not penetrate, so it has but little direct effect on the deeper structures." Yet he goes on to say that it "is useful in chronic gout, rheumatism, dyspepsia, and insomnia, neuralgia, writer's cramp, neurasthenia, functional aphonia, chorea, and other nervous affections."

As not one of these troublesome diseases is an affection of the skin, it would seem that the incongruity between the statement that static electricity expends itself on the surface of the body and that it cures such non-cutaneous diseases as dyspepsia, gout, and chorea, would strike every intelligent physician, even while he was copying the paragraph.

CHAPTER III.

THE CARE OF THE HOLTZ MACHINE.

Proper arrangement of machine in office. How to keep the interior dry. Method of grounding poles and electrodes. Conduction from machine to patient. Care of case, oiling, and charging. Reverse of polarity and how to correct. Tests for distinguishing positive and negative pole. Operation of the static machine in summer. Motor. Attachment of belt, proper adjustment, cleaning, oiling, and precautions to avoid injury. Rheostat to regulate speed.

It is an important starting-point in the perfect working of the static machine that it should be properly set up in the physician's office. It should stand evenly and firmly upon the floors so that when in rapid motion it will neither jar nor shake.

If it is run by a motor, the belt should be joined by a small steel hook embedded into the leather and make no click when it meets the wheel. The plates, combs, collectors, and all the internal parts should be correctly adjusted so that none grate or rub upon each other. Without an accurate adjustment of the machine it cannot be expected to operate satisfactorily.

The revolving glass plates should turn evenly and smoothly, and when everything is in proper order the machine should be nearly noiseless when in action. In many respects the care required by a static machine resembles the care usually bestowed upon a choice piano.

It should be placed in a large and dry room. An inner room, or one in which the sun freely enters, is to be preferred. It should be covered when not in use, and should be daily dusted, and its metallic parts kept bright with a rouged chamois. The electrodes should be similarly treated.

There exists an active affinity between all parts of a static machine and the floating particles of dust in the atmosphere of

a room, and for this reason it should be protected from dust as much as possible.

Attention to these details will maintain the beautiful appearance of the machine and keep it from looking tarnished and neglected. The entire case, metal parts, platform, rod, and chains should be kept scrupulously clean.

When the machine is first purchased the external brass parts and electrodes will be found coated with shellac which is a bad conductor. It must be dissolved with alcohol and entirely removed from the sliding poles, rod, and metal parts of all the electrodes.

At the very commencement the interior of the case must be thoroughly dry and ever after kept so. The method of keeping the interior dry deserves special attention, for the successful employment of the machine depends much upon the absence of internal moisture.

During the seasons of the year when the atmosphere of the house or office is artificially dried by furnace or other heat there will of course be no additional necessity to dry the interior of the machine, but in summer when no fire is used and when the doors and windows are frequently open, every misty or rainy day will saturate the air of the house with moisture. This is the period of discontent for the static machine, but its evils are moderated by judicious care. Various expedients have been suggested to dry the internal plates, but one and all methods heretofore mentioned for this purpose should be discarded for the following plan, which is now universally adopted as the best.

Obtain two or four fire-proof dishes or bowls of common white crockery, not too large to enter the case, but sufficient to hold together ten pounds of chloride of calcium. It is furnished in hermetically sealed containers of ten pounds each. It is usually taken from the can and put directly into the machine by uninstructed operators, but this should never be done, for it is exceedingly hygroscopic and always contains more or less water when purchased. Unless this is first evaporated and the

chloride thoroughly dried it will liquefy more rapidly and be far less effective in the case.

Accordingly divide the contents of the can between the dishes and bake them in a moderate oven until the calcium is white as chalk. It may take but an hour or two, or an entire day, depending on the quantity of moisture to dry out and the relative heat of the oven, but bake it till it is thoroughly dry no matter how long it takes.

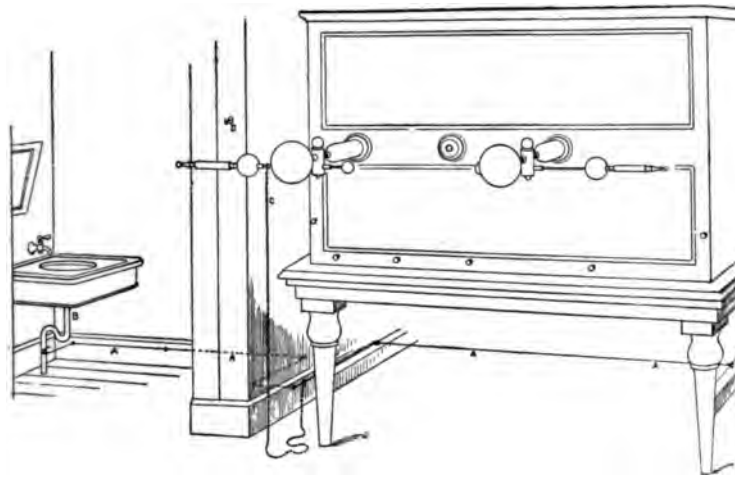
The heat should not be sufficient to boil the water (if part of the chloride is in a liquid state), or it will run over the edge of the dish and not only waste but necessitate cleaning the oven. Never let any liquefied chloride of calcium spill on a carpet or the floor of the office, for it is a disagreeable substance.

When an examination shows the baking to be thoroughly done remove the dishes from the oven to a suitable pan, cover them with a dry towel, carry them to the machine, and transfer them quickly to its interior. Instantly screw fast the doors. The machine will then be ready to operate.

The chloride of calcium may be rebaked as often as necessary, and by using dishes that can be put in the oven without injury the same material can be utilized again and again with very little waste. I use the same chloride for at least a year before throwing it away and procuring a fresh can. In the winter time it remains dry and is practically not needed within the machine, but I leave it there because it is the safest place to store it where it can be found. In the spring and fall seasons I take it out about once a month and in the worst of dog-days about once a week, but the actual state of the chloride is the indication for baking it again and not the lapse of any particular time.

The next and more important matter to attend to after a new machine is set up in running order in the office is to provide metallic groundings for both poles, and for the several electrodes.

Uninstructed operators often drop a chain from the sliding



Grounding to the Water Pipe. *AAAA* is a stout copper wire passing under the frame of the machine, through the wall, to the most convenient water pipe, *B*. This may be either in the same room or in another room. Any water pipe which can be reached with a wire from the machine will answer the purpose. *C* represents the chain dropped from the prime conductor to the floor and hooked over the wire *A*. *D* shows the hook in the wall upon which the chain is hung when not in use.

rod to the floor, but the clinical results of such physicians are not always gratifying. When a current of electricity is conducted to earth it should be by a metallic route, and a high potential difference between the static poles depends upon good conduction, as well as upon the capacity and power of the machine. Static electricity has no fixed voltage. The operator controls it by his management of the apparatus.

Two separate groundings are essential. Without them the machine loses fifty per cent. of its efficiency. If the office contains gas and water pipes both, they serve the purpose. If not, the physician can drive two pieces of iron pipe into the ground deep enough to reach moisture, and connect these with convenient situations in his office by heavy copper wires. As there are few offices which do not contain running water and gas I shall proceed to describe how to employ them as groundings.

Procure a necessary quantity of stout copper wire. Tack a piece of it under the table of the machine and carry it along the baseboard of the room to the water pipe, to which the end of the wire should be permanently fastened. This is utilized for grounding one of the poles of the machine, by linking one end of a brass chain to it, and hooking the other end of the chain upon the sliding pole which is not connected with the platform during treatment. To remove the grounding after treatment simply unhook the chain from the sliding pole and hang it on a convenient peg in the wall, or drop it on the floor.

The gas fixture grounding requires no preparation if a chandelier from the ceiling is in convenient relation to the platform and is brass. If it is bronzed iron or some composition which is a poor conductor a piece of stout copper wire should be bent into a hook at the lower end and carried up the chandelier and twisted around the gas pipe at the top. If the chandelier is not conveniently situated, or does not exist at all, a copper wire can be run from a side bracket to some point where a hook at the end will be most handy for the operator.

The above diagram illustrates the author's use of the chandelier as a grounding for either machine or electrodes as desired. Stout copper wires *AAAAA* are carried from hooks in three convenient situations upon side walls near the static machine to wires *BB* which stretch from the top of opposite doors to the central rod of the gas fixture which conducts the current to the earth. I either attach the chain of my electrode handler to the lower portion of the chandelier or to any one of these hooks, whichever is convenient for the situation in which I stand to treat a given case.

The grounding of the electrode is accomplished by attaching the swivel of another brass chain furnished with the machine to the ring upon the metallic part of the electrode and hooking the opposite end of the chain upon the chandelier or wire connected with it.

No operator who has not provided metallic conduction to earth can create a high-potential difference between the opposite polarities, and therefore cannot equal the best therapeutic work of which his machine is capable.

After providing conduction for the indifferent pole and the electrode, the next step is to provide good and direct conduction from the active pole to the patient. Poor conduction in this respect is a fruitful source of failure. If the platform surface wastes half or two-thirds of the current before it gets from the end of the rod to the patient it must be furnished with a better conductor, for extravagance in current waste is fatal to therapeutics. New platforms are sometimes varnished, shellaced, or oiled, and shellac, varnish, and oil are all bad conductors.

An oak platform with natural wood surface is probably the best for static use and this can be dampened a little from time to time and its conducting efficiency increased. Metal, however, is by far the best, although in some forms of application it possesses drawbacks which require experience to overcome. By far the most efficient way to get a current directly into the patient is through a metal tray placed under the feet, or a chain or rod held in the hands. I habitually use a brass tray about fifteen inches square, to one corner of which is attached two feet of chain. When the rod from the prime conductor is placed upon the platform in the usual way the free end of this chain is thrown around it and direct conduction is secured.

As every screw about machinery in active vibration will tend to work loose, it is necessary from time to time to tighten the screws that close the doors and secure together the framework of the static apparatus.

Every joint about the machine must be constantly kept as firmly tightened as possible. Some of the internal screws will occasionally work loose and permit two plates to rub together, or a comb to scratch and grate upon one of the revolving plates. When this happens it calls the operator's attention to it by the noise it makes and the trouble should be corrected by removing a door, setting the comb or movable plate back into proper position, tightening the screw, and closing the door again. The case, however, should be opened only when absolutely necessary, and a dry day selected for this purpose, for it at once lets the air of the room into the machine and temporarily lowers its working capacity.

Very few parts of the improved Holtz machine require oiling. One of my former machines, with an axle bearing, required regular oiling through an external oil orifice at each end of the axle, but this method allowed some air continually to enter the case and involved an extra amount of friction. My present apparatus contains ball bearings enclosed in a permanent oil bath, with no openings to let in the air, and with the friction reduced to a minimum. These bearings constitute a great improvement in the apparatus and were introduced by the manufacturers at the author's request. As a veteran bicycle rider my familiarity with the advantages of ball bearings induced me to repeatedly urge their merits upon the makers of the Holtz machine.

Charging this machine simply involves the principle of joining by metal conductors both poles of a frictional machine, which will develop electricity by friction in all atmospheres, to the two poles of an induction machine which will develop nothing until the germ of the current is supplied, setting both sets of plates into action, and continuing until the induction plates take up the minor frictional discharge and magnify it into a high-potential current.

The process may be instantaneous on a dry day, or may require a dozen seconds under ordinary circumstances. A good

deal depends on the dryness of the chloride within the large machine and on the efficiency of the small frictional apparatus. On a damp summer day I have seen a small charger that was out of order consume half an hour in charging the induction plates. A charger that will give only a quarter of an inch spark between its two poles will be very apt to do this. The charger within my present apparatus is constructed in a much better manner, with larger plates and better workmanship, and will give a one-inch spark. Its action is successful, convenient, and satisfactory.

The static machine occasionally reverses its polarity. To prevent this occurrence Holtz introduced his ingenious diagonal conductor, a device which does not fully remove the fault though it greatly increases the stability of the electrical charge. When this occurrence takes place in practice it is only necessary to become aware of it and connect the platform with the desired pole for therapeutic effects, provided that no inconvience to the operator results from the reversal.

Sometimes, however, owing to the situation of available space and the relation of office accessories, it may be a practical necessity to have the positive pole always at a particular end of the machine, where the physician becomes accustomed to its use with the most satisfactory convenience. This being my own case a few years ago, a reversal of polarity operated as a decided hindrance, and I therefore investigated the conditions which appeared to influence the shifting charge, with the result that I discovered a method of correcting the reversal and described the same in the *Medical Record*, February 24th, 1894.

Thoroughly discharge the machine and subject the plates to a sharp jar in some manner that is consistent with safety to the apparatus. With a six-plate twenty-six-inch machine the simplest method of doing this is to lift the positive end of the case a very short distance from the floor and drop it, using the precaution to avoid any damaging violence. An eight-plate thirty-inch machine is rather heavy to lift.

Other methods are: Strike a few sharp taps with a hammer on the outer end of the brass cross rod supporting the upper set of diagonal combs, jar the case by blows upon its floor or side, etc. With care no damage whatever will be done the machine.

To demonstrate success, recharge the plates and if the positive has not yet shifted as desired try it again. On a good day for static the charge is sometimes more tenacious and the object is not so readily accomplished. It then simplifies the matter to open both doors and discharge the machine more thoroughly.

To discharge the Holtz machine when desired, revolve the plates backward until no spark will pass between the sliding poles when they are brought gradually together until they touch. Then touch each prime conductor with a grounded electrode and start the machine into action in the usual way. If the machine is discharged it will now produce no current. If the attempt to discharge it has not perfectly succeeded try it again. I kept a record during one year showing that my machine reversed thirteen times and each time I corrected the change by the method above described. It sometimes took me only a moment and once or twice it required half an hour to restore the desired polar relations. In my present office I have abundant room and need make no attempt to correct reversals.

When the machine is not in action the poles should always be left some distance apart. If they are short-circuited by being placed in contact after the machine is stopped it tends to cause a discharge and require recharging the next time a patient is treated, although the state of the weather will affect this somewhat.

The physician operating a static machine must at all times know which pole is positive and negative as certainly as he must distinguish between the poles of a galvanic battery. Both my ear and eye have become so trained to the action of static currents that I am always aware which pole is being employed without making any actual test to discover. The difference be-

tween the two is manifested in many ways. To make a direct test, put the poles one or two inches apart and start the machine into slow action. Watch the poles and the first spark will be seen to jump from one ball to the other.

If this is detected by the eye it instantly shows that the pole from which the spark jumped was the positive.

With the spark stream now in full and continuous action it will be seen to be a violet tint for nearly half its length at one end and bright at the other end. The violet tint shows the negative pole, the white light shows the positive pole.

Also pull the rods slowly apart until the brush discharge between them splits. From the positive pole there will be a single straight "handle" from the brass ball to the brush, while the negative end will have no defined and single "handle." Draw the poles still farther apart until the brush divides. With a good machine, a dry room fairly darkened, and a high speed of the plates, the famous fox's tail will flare in splendid radiance between the poles. It never remains upon the negative.

If none of these several steps of an ordinary test satisfy the beginner who has not yet acquired the confidence of experience, place the sliding poles about six inches apart or so that the discharge between them is a compact stream instead of a scattered brush.

Ground the brass point electrode and put its point in the course of the spark stream at either pole. It is obvious that interference with a jet of water at its terminus will scatter but not abolish the jet, while interference at its source will deflect it or even stop it altogether. As the current passes from the positive to the negative the grounded electrode placed at the positive pole will completely abolish the spark stream by conducting it away. If the electrode interferes at the negative pole the spark stream will persist from its positive source and will be affected only at its terminus.

With a small machine and a moderate current this latter test is easily made with a match held in the hand, as I have formerly

described; but with a powerful machine and a strong current the electrode is a more agreeable means.

Operation of the Static Machine in Summer.—I have often been spoken to by physicians about the trouble they experience in getting an adequate current into the patient during rainy seasons in July and August. In some cases their machine gives a good discharge between the sliding poles, but little or nothing reaches the patient.

It is difficult to say at a distance what may be the cause of the trouble in any given case. Non-experts sometimes think their machines are in perfect order when they are actually the reverse. They may also regard the conditions of the room favorably when the trained operator of static apparatus would at once detect a weak point.

If the machine and room are dry and in good order the work done in July and August should rarely disappoint. In my own case I have entire confidence that my machine will work on every day in the year, for if it fails for a moment I speedily correct the trouble. The mastery of the conditions which enables me to do this can be acquired by other physicians without a doubt. I have never failed to quickly discover the cause of defective action in the case of machines in other offices when I have been able to make a personal examination, even through previous correspondence failed utterly to suggest the trouble.

It should be remembered, however, that few owners of static machines have been carefully instructed in their management. They have usually bought an apparatus and picked up haphazard their slender stock of knowledge about it. The machine is far too valuable to be viewed in an indifferent manner and it will well repay the time and cost to procure the best instruction possible.

Motor.—The consideration of motor power in connection with the static apparatus is quite important. Physicians in different localities have different methods available. Some will find it necessary to employ water as the power. Some have

put in small gas engines. Some engage a boy to turn the machine. But wherever an electric street current is available an electric motor is the most satisfactory method.

A primary battery for power is out of the question, and secondary cells would be inconvenient, expensive to operate, and are also practically out of the question at the present time. When an alternating current runs through the physician's street there is, I am informed, some difficulty in obtaining a small motor that it will operate with satisfaction. The direct 110-volt current is available in many places, and, as my personal experience is limited to this current, I will describe only what I employ myself.

I have a one-sixth horse-power Crocker-Wheeler motor. A one-eighth or even one-twelfth horse-power will run a static machine in perfect order, in perhaps half of its work, but as time goes by, and the plates may sometimes rub against each other and greater resistance may develop from other causes, it is wise to have some power to spare, and for this reason a one-sixth horse-power motor is always preferable.

I employ but a single belt, running directly from the central shaft to the motor. My machine has no fly-wheel, but the Wimshurst charger is operated by hand with superior convenience whenever it is needed. The use of the fly-wheel to operate both the charger and the larger plates involves some minor drawbacks. The additional friction is something, but the wobbling appearance of the revolving wheel, which is almost always in the eye of the patient and the physician, becomes very unpleasant to any one who is accustomed to an invisible mechanism.

I regulate the speed of the motor by a rheostat which was made especially for me. It has a resistance of 125 ohms, divided into 25 steps, so that the switch gives very even gradations of speed from the maximum down to a complete standstill.

When the machine is not in action the current should not be left passing through the fields of the motor, but should be

switched entirely out of circuit in the way that an electric light is cut out. I have such a switch attached to the wall near my machine so that when not in use no current enters either the rheostat, the motor, or the flexible cords, and all danger of heating is eliminated from the portion of the circuit which is inside the office.

A new motor will almost always give a little trouble until it gets settled to working order. It must receive sufficient, but very simple, care. The oil cups will need filling once in about two or three weeks. Whenever the commutator becomes blackened it should be made to revolve while a piece of OO sandpaper is held against it to remove the carbon. If too much oil is put in the bearings it will at times work up on the commutator and must be wiped off with a clean rag.

It is of the first importance to have the brushes in proper relation to each other, and to the centre of commutation, in a given motor. These centres differ in different types, and ordinary electrical workmen who simply wire houses for bells and lights are almost always ignorant about the adjustment of a motor, and will leave the brushes in a position that will encourage heat effects and possibly sometimes ruin the motor coils. I speak of this because of a personal experience with the ability of workmen to botch a job they do not understand.

If, when the motor is put in position, the wheel revolves the wrong way, it can be reversed by simply transferring the two short wires which connect its opposite poles.

Whenever the belt stretches it should be promptly tightened so that it will not slip on the small wheel.

Those who may order a rheostat for the control of a one-sixth horse-power motor would do well to specify a resistance of 175 ohms instead of 125, and the higher resistance will give control over the speed when the machine is short-circuited and running without resistance. I employ a bank of lamps for this purpose, but when the apparatus is all purchased at once the rheostat can easily include all the resistance that may be needed.

CHAPTER IV.

THERAPEUTIC METHODS.

Necessary electrodes. The importance of a proper platform. Leakage. Positive electrification. Negative electrification. Potential alternation, technique in full. Positive static breeze. Continuous and interrupted methods of administering the breeze. Negative static breeze. Positive or negative static spray. The static cage. Its action as an electrode. Methods of use in full with both oscillating and continuous currents. General indications for the use of the static cage. Static sparks, frictional and percussive. Leyden-jar currents.

THIS subject must be considered of the utmost importance to the physician, and it is my purpose to treat the matter as fully and plainly as can be done in writing.

The accessories desirable for such a therapeutic Holtz machine as the author employs are: One long brass rod to connect the prime conductor with the platform; three long brass chains; three pairs of Leyden jars, small, medium, and large; an adjustable and movable standard for supporting a stationary electrode; a swinging brass rod attached to top of the case for head-breeze administrations; separate electrodes with hard-rubber insulating handles—brass spark ball three inches in diameter, a small brass spark ball three-quarters of an inch in diameter, a spark electrode within a protecting glass shield, single brass point; a multiple-point electrode of long fine needles, preferably copper; wooden point, wooden ball, massage roller, hard-rubber handles for Leyden-jar electrodes. Conducting cords and all varieties of electrodes employed with coil currents are available for Leyden-jar currents, and no special electrodes are required.

The great variety of effects obtained from static currents are to be produced by the great variety of practical manipulations

Set of Electrodes and Standard furnished with the Static Machine by the Manufacturers.

of current strength, conditions of treatment, and a few essential electrodes, rather than by multiplying the number of electrodes.

The traditional umbrella crown electrode is superseded by a small group of pointed and fine wires bunched together. This produces a concentrated head breeze instead of the diffused scattering of the current caused by the umbrella. As a practical electrode the large, clumsy, but time-honored umbrella is contrary to the established principles of therapeutic breeze application.

The improved platform of to-day is the most essential accessory accompanying the static machine. The ordinary size is forty-two inches long by twenty-seven wide and is supported a foot above the floor by solid glass legs. All corners and edges are rounded. The early, square-edged, sharp-cornered platforms, with wooden legs set into common glass cups, leaked off a large amount of current, and are obsolete. All who are still using such an inferior platform should procure a better one. I have seen men who deemed themselves very experienced with static electricity still use one of these worthless and long since rejected platforms, without realizing that they were wasting half the current that should have reached the patient. A good platform that will insulate the patient effectively is a cheap investment and an absolute necessity.

The author's insulated electrode handler is also a practical requirement for the physician.

Another extremely important accessory part of the static machine is the means of connecting the Leyden jars with the prime conductors. In one of my former machines these hooked directly upon the pole piece, and the hard-rubber supports for the sliding rods were solid at the base, and allowed little leakage. My present apparatus, however, was fitted when first purchased with a jointed rod device, and instead of being solid, the hard-rubber knob beneath each pole piece was open at the bottom and fitted with a brass screw, into which the jointed rod was secured. The result was found to be a leakage so great

as to be fatal to X-ray work with tubes of high resistance, and to reduce the therapeutic efficiency of electrification by at least one-fourth.

So great was the leakage that it was impossible to procure between the sliding poles the splendid luminous displays and "fox tail" or whisk broom, which ought to be visible at the positive pole in a dark room. It is wise to speak of this point because a number of physicians may be employing a similarly constructed apparatus without suspecting the reason why they cannot equal reported results. This defect has since been corrected, and can be rectified upon any apparatus of this kind in use.

Physicians accustomed to the administration of electric currents created by chemical action are somewhat confused when they first attempt the different applications of static electricity, which will now be explained in detail.

Positive Electrification.—Seat the patient upon the platform, with the platform related to the machine so that the brass rod will conveniently reach from its nearest side to the prime conductor.

It should not be under a gas fixture, or within a couple of feet of other office furniture, and as a general rule the more free room around the platform the better.

The side of the patient nearest the machine should be two feet or more from the grounded pole, or otherwise a strong current, woollen garments, and the negative attraction may annoy the patient with an irritating breeze.

In hooking the "shepherd's-crook" rod over the positive pole it should be hooked with the ball extremity uppermost, and close up to the large ball of the prime conductor, to prevent leakage. It is usually thrown over the rod in a careless manner with the ball projecting downward and toward the machine. This is a bad method and wastes the current. The "crook" at the end of the platform rod should be bent for practical use until the ball and the neck are within an inch of each other.

As usually furnished by makers it is an ornamental but not practical shape.

Hook upon the negative pole of the machine the free end of the brass chain which has already been linked to the copper wire passing from the baseboard to the water pipe or gas fixture. This grounds the negative pole.

Place a metal foot-plate, or tray, under the patient's feet, and connect it with the lower end of the platform rod by a piece of chain attached to it for this purpose.

In this application, and at all times whenever any ordinary form of treatment is given upon the insulating platform, the sliding poles of the machine are to be drawn their full width apart. They are only brought near together when Leyden-jar currents are employed.

Next, start the machine into action and cause the plates to revolve as rapidly as they can without either racing or sparking within the case.

In dry, wintry weather a highly insulated positive pole will sometimes drive sparks between the metal parts within the case and startle a timid patient. Reducing the speed of the machine will avoid this, but it should be remembered at all times that simple general electrification requires a maximum current strength for maximum beneficial effects.

If no local or other application is made at the same sitting positive electrification is usually maintained about fifteen minutes, but often requires a longer time for full effects.

Negative Electrification.—Each step of the process exactly repeats what was done for positive electrification except that the rod is hooked to the negative pole and the grounding chain is hooked to the positive. The machine never sparks back with this low potential polarity, and the patient may either sit with feet upon the tray or hold the rod in her hands, while a maximum current is maintained. There is no liability of causing irritation through woollen garments by the attraction of neighboring objects.

Potential Alternation.—The above two methods are a continuous general electrification. Potential alternation, as described by the author in 1893, constitutes an interrupted and oscillating, vibratory, general electrification. It may be considered as adding force to the continuous current, something as a hammer blow adds force to continuous pressure, and is a more energizing tonic than the primary method.

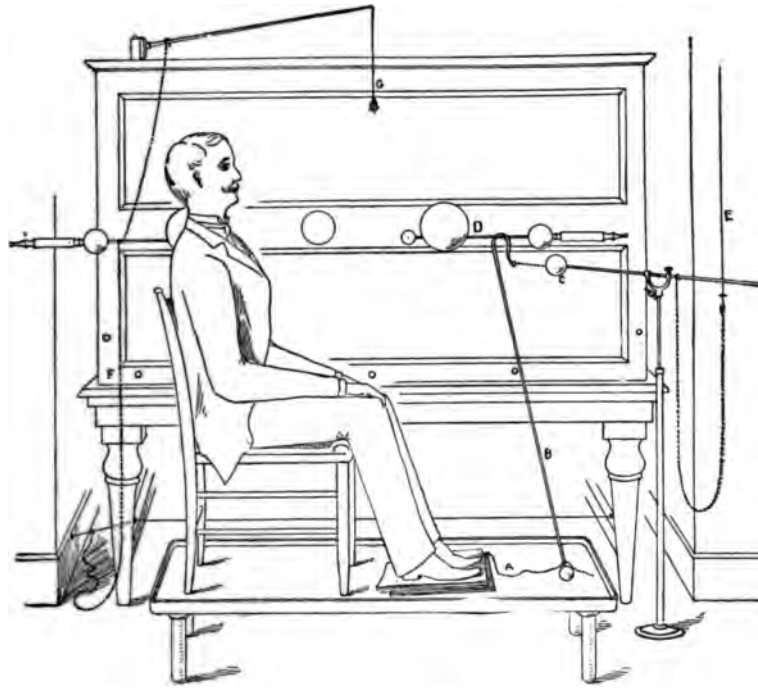
Either remove the patient's shoes and place the stocking feet upon a reservoir electrode filled, for comfort, with warm water, or, if this is too much trouble with high-laced shoes, leave them on and insulate the nails in the heels by putting three or four folded newspapers between the shoes and the metal foot-plate.

If shoes are worn without such protection the interrupted current will pass up the nails, and through the soles of the shoes, in a succession of sparks, and the tolerance of the feet would not permit the current to be made strong enough to affect the rest of the body.

Next prepare the platform rod the same as for simple positive electrification, and ground the negative pole. Fix the large brass ball spark electrode upon the movable standard and place it beside the positive prime conductor so that the balls of the electrode and the "shepherd's crook" will touch each other. Ground the electrode to the gas fixture if the negative pole is grounded to the water pipe. Different groundings in this case are essential.

Over the head of the patient arrange the head-breeze electrode, and attach to it the same chain which connects the negative pole to the water pipe. Adjust the head electrode so that it shall be about three feet distant from the patient.

Start the machine into rapid action and gradually draw the ball electrode away from the shepherd's crook so that finally the length of spark which passes between the two will cause a gentle thrill that does not exceed comfort in the patient's feet; at the same time, vigorous oscillations will be seen in the patient's hair.



Potential Alternation. *A* chain from rod *B* to positive pole *D*. Patient's feet are protected by several large electrical journals placed over the brass tray. *C* is the ball electrode placed upon the standard and grounded by chain to wire *E* passing to gas fixture. The opposite grounding chain *F* connects the negative pole with the head-breeze electrode *G*, grounding both. *G* is about three feet distant from the patient's head. The dotted lines between *C* and the terminus of the shepherd's crook indicate the spark gap interrupting the current when the machine is in rapid action. The usual length of this spark gap is from four to six inches.

The operator may use a single hand to move the spark electrode. Never touch the standard with both hands while the long spark is passing.

The patient must keep both feet flat in contact with the platform. If one foot is lifted the density doubles as the contact area is divided, and hence a current strength that is proper for this treatment might be exceedingly disagreeable if concentrated upon one foot.

I am often asked what should be the length of spark between the interrupting electrode and the positive pole. Spark lengths will vary according to conditions, and the dose is not regulated by inches. Oscillations should be obtained which will set the atmosphere and hair of the patient in that degree of powerful commotion which, in a given case, experience demonstrates to produce the most sedative-tonic effect. As a matter of fact the spark streams, which I have often measured to gratify inquiring physicians, have varied from three to seven inches in length, with an average, probably, of about five.

The same method can be pursued with the negative pole, but the high potential polarity is more effective and hence preferable.

Positive Static Breeze.—Arrange patient and machine attachments the same as for negative electrification, and ground the positive pole to the wire near it, which has previously been brought from the gas fixture to a situation near the machine, convenient for this purpose.

The breeze may apply a continuous or an interrupted current and the electrode may be in motion or stationary.

For a stationary breeze upon the head, forehead, occiput, joint, or any localized part of the spine or body, fix a brass point electrode upon the standard and set it at a proper distance from the part to be treated.

For a vertex head breeze, simply swing out the hinged rod screwed upon an upper corner of the case of the machine, and suspend the small bunch of wires, elsewhere alluded to, over

the patient's head—twelve to twenty-four inches, according to the thickness and resistance of the patient's hair and the effect desired. For this purpose my own special head-breeze electrode consists of half a box of exceedingly fine, French gilt hairpins which I wound together at the top with a small piece of wire, flared the points slightly apart, and suspended them by a foot of copper wire to the extremity of my swinging rod.

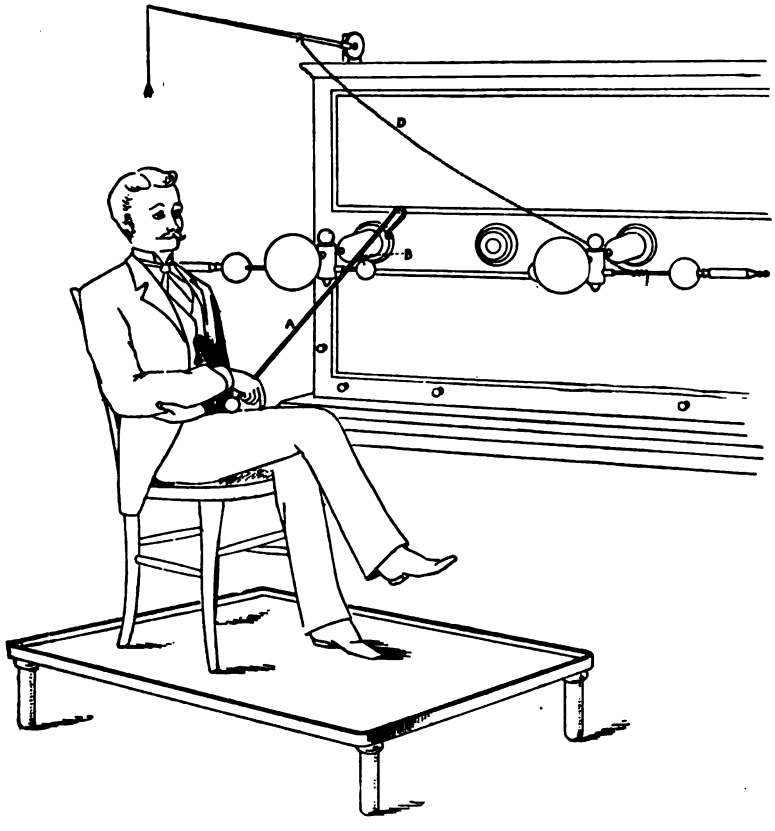
When all is ready ground the electrode to the gas fixture and start the machine into action.

Regulation of speed, distance from point to patient, length of application, and all that constitutes the dose, depend upon the therapeutic indications and call for operative skill on the physician's part.

A moving positive breeze is administered by attaching the brass point electrode to a chain, hooking the chain to the gas fixture, and manipulating the point with rapid or slow sweeping motions, at greater or less distances, over a given part, according to the effect desired.

To apply either a stationary or moving breeze in the most effective manner the method taught by the author of interrupting the current before it gets to the patient is superior to the method sometimes employed of interrupting the breeze on its way to the earth. This latter method adds no efficiency to the treatment, although it will eliminate the irritation of a negative head breeze upon a thick head of hair, or through woollen garments upon other parts of the body. The author's method, however, not only eliminates negative irritation, but tremendously accelerates the current force with which the patient is electrified. This is one of the rudimentary things I demonstrate to all my students. All other steps of the process are the same as for a continuous breeze.

To cause the interruption the patient holds the platform rod in her hands, rests the crook conveniently upon the frame of the case, in such a way that the rod can be steadily and easily held at the distance of an inch, more or less, from whichever



Author's Interrupted Head Breeze. *A*, Rod connecting patient and platform to positive pole; *D*, chains connecting head-breeze electrode with opposite pole and passing on to the usual grounding. *A* rests upon the side of the case and is separated from the prime conductor by about three-quarters of an inch. The dotted lines *B* indicate the spark stream which passes between the rod and the prime conductor to interrupt and modify the breeze application. The principle is the same with either pole, but the positive head breeze never requires interrupting.

prime conductor is chosen for the treatment. A spark stream will pass between the pole and the rod as soon as the machine is started into action. The plates should revolve quite rapidly and by increasing or decreasing the spark gap, the interruptions may be made either slower or faster, milder or more vigorous, and the intensity of the treatment regulated. Further regulation is attained by varying the speed of the plates and the distance between the electrode and the patient.

Negative Static Breeze.—All that has been said about the method of applying the positive breeze equally describes the negative breeze administration, except that the high potential positive pole must be connected with the platform. Electrodes are grounded and manipulated in the same way as before, with only such differences as the more irritating qualities of the strong negative breeze through resisting garments require. It is not irritating through cotton fabrics or on bare skin.

Positive or Negative Static Spray.—Spray applications simply intensify either the continuous or interrupted static breeze by throwing from the point of the electrode manipulated by the operator a convective shower of visible electrified particles of air.

For this purpose the electrode must be swept sufficiently near the patient, and the development of all the useful sedative, tonic, stimulating, counter-irritant, and rubefacient effects of which this method is capable calls for familiarity with the physiological actions of static electricity, and considerable experience and operative skill.

Massage Roller Applications.—The regulation of intensity and muscle effects with this method depends upon the distance between the two sliding poles, which are first brought near together and gradually drawn apart to increase the current strength.

The electrode is connected to a chain in the usual manner. It may then be employed with the following variations:

1. Attach the chain to either the negative or positive pole,

apply the electrode to the insulated patient, and ground the opposite pole.

2. Connect the platform and the machine with the rod as usual, and attach the electrode to the opposite pole, which is also grounded.

In the above applications the selection of poles is the same as for the static breeze. If the patient is connected with the positive pole its higher voltage gives greater intensity and heating and counter-irritant effects.

The poles may also be drawn wide apart and the electrode manipulated by the patient over the affected part while the operator interrupts the current with the spark-ball electrode upon the same prime conductor.

The roller may also be used with the Leyden-jar current by placing the bare feet upon a foot electrode connected with the negative Leyden jar while the operator passes the roller over the surface of the body. In this case the roller is connected with the positive Leyden jar and the strength of the application is regulated by the distance between the sliding poles.

These applications are nearly the same as the short frictional spark when counter-irritant effects are produced, but can be made to equal a slowly interrupted current to exercise muscles in a manner similar to massage.

The Static Cage.—This, when brought to general notice by descriptions in medical journals, has excited the interest of physicians, who presumed it to be either a new method or a method producing exceptional and superior effects.

The application of the static breeze to the head and spine, or entire body, by a breeze electrode fixed above the patient upon a standard, or by the brass point electrode manipulated near the patient by the hand of the operator, is about as old as the static machine. It has been practised nearly a hundred and fifty years. It is a utilization of the law that opposite electricities attract each other, and is a means of increasing the rate of change in the patient's positive or negative charge, or of local-

izing the area of diffusion from the entire body to a part upon which effect is concentrated.

When the point electrode is held near any part of the body it rapidly attracts off the insulated patient's electric charge, and is felt as a breeze upon the surface; and when the principle of the point as an attracting magnet is amplified by multiplying the number of points, arranging them in a circle surrounding the patient's body, or suspending them like canopy above the reclining person, the result is a diffused breeze upon a large area instead of a concentrated breeze upon a small area.

When this method was first brought to my attention in 1894 it was stated to involve a process of auto-induction; inductive currents being set up in the patient's body by the surrounding "solenoid." A single personal experience disclosed at once the error of this view and revealed the cage as simply an expanded breeze electrode. Those who wish to make one can easily do so at a small expense and use it when it may serve. No exaggerated value can be attached to it, but it lends variety to methods which accomplish about the same result.

The indications for its use are general functional neuroses and diseases associated with perverted nutrition.

It is constitutional rather than local treatment and adds rapidity to the rate of change (current flow) of general electrification.

The cage may alarm very timid or hysterical subjects, and may be inconvenient to use upon some others. It is best adapted to men, or young girls or women who are rather trimly dressed, and who can easily stand within the cage in the required manner during the ten or more minutes of the application.

The effects parallel those attributed to high-potential currents of high frequency by French investigators during the past four years. The expert can vary the cage application in a number of ways, and interrupt the current by approximating the sliding poles, or by the author's method of potential alternation. In

ordinary hands, however, the methods which are simplest and serve every purpose are the following:

1. Negative electrification with either constant or oscillatory positive breeze.

2. Positive electrification with oscillating breeze.

Have the patient remove shoes and stand in stocking feet upon the reservoir foot electrode, which should be filled with warm water as a matter of comfort, for a cold foot-plate is disagreeable to most persons in cold weather.

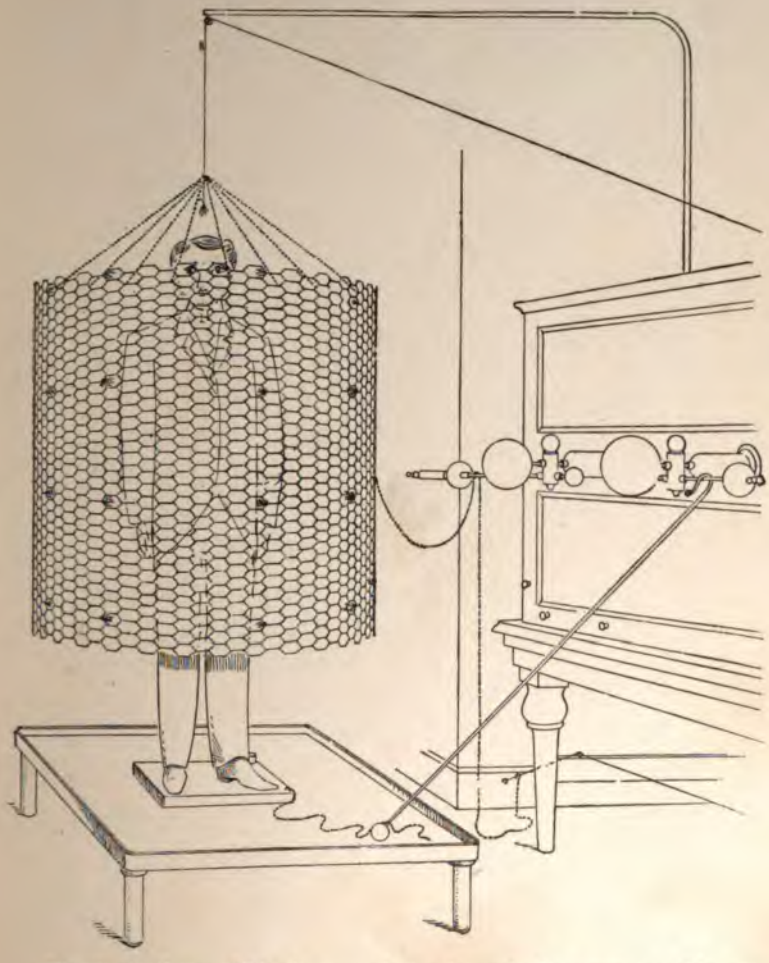
From this electrode, connection is made to the platform rod and prime conductor of the machine. The rod is placed upon the platform in the usual manner. The cage is now lowered over the patient so that he or she stands in the centre, with a distance of about six inches between the top of the head and the chains suspending the cage.

The prime conductor not connected with the platform is both grounded and connected with the metallic cage by the usual grounding chain, passed first over the sliding pole and then hooked to the cage.

The sliding poles are short-circuited, and the machine is now started into action. The poles are next drawn apart about one inch. The exact distance is regulated by the sensation in the patient's feet, which should not exceed an entirely comfortable thrill. If drawn too far apart the spark stream will cease to pass between the poles, and this fact also requires that they should be kept near together.

This constitutes the oscillating breeze, and may be administered for five, ten, or more minutes, according to the operator's judgment. The technique is the same with either pole. With the negative charge it is bland and cool; with the positive charge it is more irritating or stimulating if garments make it so, but both can be made agreeable to the patient.

It is well to test the milder negative electrification first, as patients may be so dressed that the positive charge and negative breeze are too irritating to the skin beneath their garments.



The Static Cage. This diagram shows the author's apparatus with great completeness. The patient stands upon the metallic foot-plate filled with warm water and connected by a piece of brass chain to the rod passing to the pole of the machine. The opposite pole is grounded and the same chain is hooked to the cage. The cage is suspended upon the frame and is raised and lowered by the stout cord passing through the pulley. When not in use the cage stands upon the top of my static machine. The patient may sit upon a stool if desired. The cage may be adjusted to any height.

This is most likely to be the case with loosely woven, woollen fabrics, metallic hairpins, metallic dress trimmings, and corset steels, and no one should treat a patient with the negative breeze until he has familiarized himself with the sensations set up by different dress goods of higher or lower resistances. The removal of the outer coat often corrects the trouble.

The oscillatory application requires the passage of a stream of interrupting sparks between the prime conductors of the machine and is the most effective tonic manner of using the cage. The author's method of potential alternation, however, practically furnishes the same effect in a simpler way and obviates the necessity of employing the more troublesome electrode.

To produce a simple breeze it is only necessary to draw the poles apart at the beginning instead of sliding them together. The current is then continuous, instead of interrupted, and does not differ except in the size of the electrode from any other continuous static breeze.

The cage is a "general-electrization" method, and applies to the usual range of cases in which static electricity is of recognized benefit, particularly functional nervous disturbances, and is a sedative or stimulating tonic. It is not especially suggested in the therapeutic, itemized paragraphs of this book, for the reason that few possess the appliance, and those who do can readily comprehend its uses and employ it as opportunity permits.

Positive Static Sparks, Frictional and Percussive.—Arrange patient and machine attachments the same as for negative electrification and ground the positive pole to the conducting wire from the gas fixture, or to the chandelier.

Take in hand the large brass ball electrode, attach to it the swivel of the author's insulated electrode handler, hook the opposite end of the chain to the gas fixture, and with a quick stroke throw the ball so near any selected part of the patient that a single, thick, long spark will pass. Instantly withdraw the electrode.

Repetitions of this act, following each other with greater or less rapidity, constitute a spark treatment. Operative skill and judgment regulate all that pertains to dosage in the usual manner.

The short frictional-spark application is quite the opposite of this, and is made by rapidly rubbing the ball electrode over the surface of the patient's clothing so that the current will pass through the resisting medium in a fiery trail of sharp, needle-like, minute sparks, as long only as the garments are thick.

The percussive spark may be almost any length from one to six inches, and is a single discharge. Frictional sparks are multiple, and from one-quarter to one-half of an inch only in length.

A second method of producing a similar trail of pointed darts consists in sweeping the brass point electrode nearer the patient than in administering a static spray, and thereby throwing a shower of fine sparks as the point is swept across the surface. The brass-point electrode can be made to apply a breeze, spray, frictional sparks, or single percussive sparks, with equal effectiveness if the operator knows how.

Leyden-Jar Currents.—We now leave behind the applications of static electricity which are without parallel methods in therapeutics, and enter the field occupied by currents from induction coils, long known as faradic.

A pair of Leyden jars of one of the three sizes accompanying the machine is selected and placed in proper relation to the prime conductors. The sliding poles are brought together. A pair of the usual conducting cords is connected with the Leyden-jar attachments, and the free ends of the cords are attached to any form of electrodes employed with interrupted currents. The electrodes must be moistened if they are covered with sponge or felt. They must be placed in actual contact with the skin, and, so far as relates to disrobing the patient and manipulating the electrodes, the employment of Leyden-jar currents is the same as the employment of faradic currents. The platform

is not used. There is no insulation. The current is condensed within the Leyden jar, and discharged from it to the patient, in a more or less rapid series of discharges, which are regulated by the operator. The outer coatings of the jar must not be connected by the rod which joins them for sparks.

A closed circuit of current flow is established when the electrodes are both in contact with the patient.

A slow revolution of the machine causes sparks to pass slowly, and, if the electrodes are applied to muscles, will set up slow contractions which are marked by great energy and painlessness. The poles may be sufficiently separated to obtain the desired dose, but will exceed tolerance if too long a spark is passed. A range of one-half to two inches covers about the current strengths employed. When the plates are more rapidly revolved, the effect varies exactly as faradic currents vary with the rate of interruption.

Rapid revolutions and a rapid stream of sparks produce a high-tension current, which may be increased or diminished in strength according to the distance between the poles. A chapter might be devoted to this current alone if its various uses were described, but as it would chiefly repeat what is said in the author's work on "The Treatment of Disease by Electric Currents" of the application of all other induction currents, a full account would be superfluous. Suffice it to say that it is employed precisely as faradic-coil currents are applied, and not only may duplicate in the hands of an expert every external application customary with faradism, but goes beyond the latter in some of its effects.

The portability of the one and the cumbersomeness of the other apparatus, as well as the independence of coil currents to atmospheric influences, prevent, of course, the entire substitution of the static machine for both faradic and sinusoidal apparatus, notwithstanding that, so far as mere ability to obtain effects is concerned, the static covers about the same range as the other two.

In addition to the usual regulation of dosage when electrodes are attached to terminals upon the machine, a shunt may be em-

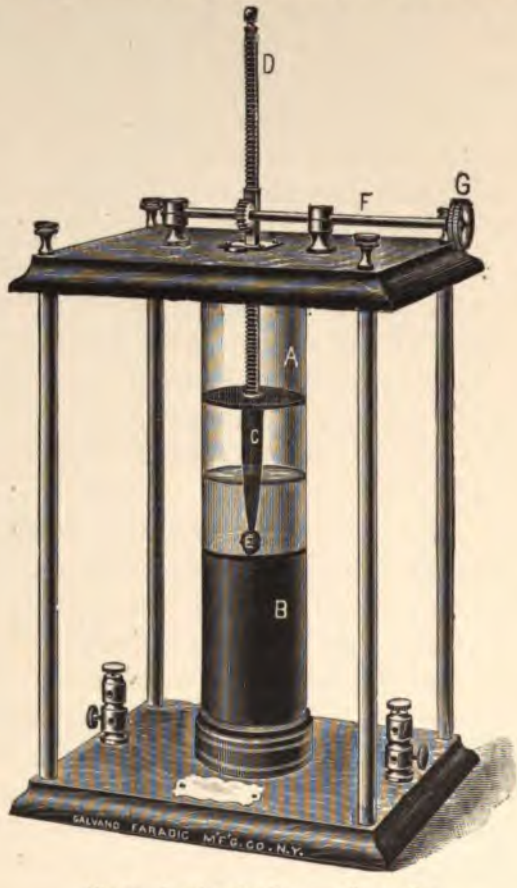


Fig. 1.—Leyden-Jar Current Controller.

ployed and current strength controlled on the reverse principle of the ordinary rheostat.

Fig. 1 illustrates this current controller, which is a perfectly satisfactory instrument.

CHAPTER V.

PLATFORM METHODS IN GENERAL.

Principles of current accumulation for therapeutic uses. Arrangement of patient on the static platform. Therapeutic actions of general electrification. Its sedative-tonic effect. The therapeutic choice of poles. Polar differences relate to voltage rather than chemical action. The therapeutic actions of breeze applications of all varieties. The influence of clothing in modifying the breeze. Precautions to avoid annoyance to patients. The therapeutic action of static sparks. How to modify the spark. Precautions to avoid discomfort to patients. Anatomical localities to be avoided in giving sparks. The technique and action of "friction" sparks. Counter-irritant effects. The therapeutic action of "potential-alternation" method, both general and local. Complexion effects. Useful hints.

In general, the methods of employing static electricity are in marked contrast to the applications of other currents. Instead of placing certain tissues, or portions of the patient's body, between two electrodes, and affecting chiefly or only the included parts by employing a current with a direct circuit flow and little or no lateral dispersion, we transform our entire patient into one great electrode by seating him upon the insulated terminus of the acting pole of the machine, producing a complete general electrification, which constitutes the basis of all static treatment. Upon this all local applications are grafted. The other pole is usually connected with the earth and disregarded in general treatment.

When the machine is started into action a separation of the collected electricity into positive and negative takes place. Each dissociated portion of the electric force, being self-repellant, strives to escape from the enclosing case of the machine by a separate channel, and the result is a continuous flow from the higher to the lower potential. The flow from one half of the revolving glass plates is carried off to the earth by the

chain attached for this purpose to the unused conductor, while that from the opposite half of the plates is conveyed by a conducting rod or chain to the insulated platform, where its downward flow is headed off and a remarkable phenomenon takes place. Unable to pass down the glass supports of the platform to reach the great negative magnet the earth, the swift output of the machine *accumulates* like a fast-rising flood, escaping upward and outward at every point where the tension of insulation gives way. The accumulation from a powerful machine is thus sufficient to form a great electric pool upon the platform, in which the patient is invisibly bathed, becoming electrified with the same potential as the prime conductor to which he is attached; and he is charged everywhere alike throughout every tissue, filament, and fibre of his body, for it is a law in electrics that "the potential inside a conductor has the same value as at any point on its surface."

There is no clothing to remove, no current direction (ascending or descending) to take into account, and no rheostat is required to govern the current strength of general electrization.

The individual upon the platform is simply permeated from foot to head, not with a galvanic streak shot through him from point to point, but by an electric force of illimitable dispersive power, and a penetrating energy that laughs at the resistance of the human tissues.

Without *accumulation* there could be no therapeutic employment of static electricity, owing to the small quantity of the current stream. To illustrate this, we may stand the patient upon the floor instead of the insulated stool, and place the hand upon the conductor as before.

The current now flows through the body to the earth at its normal rate of strength (quantity), but no crackling sound is heard as it escapes, no hair stands erect upon the head, and the spark from the largest ball electrode is so small and feeble that, to obtain it, the electrode must be held within about half an inch of contact. Various tests of this kind may be made by

each operator for himself, and by personal experimentation alone can the physician become intelligently familiar with every phase of action of the static machine.

In placing the patient on the platform it is necessary to see that the dress does not drag on the floor at any point to leak off the current.

For practical treatment any ordinary wooden chair with or without a back may be employed. A simple cane-seated stool is necessary for general purposes. The chair may be any form, rocker, reclining, or upright, and may be seated with cane or leather, but must be devoid of all metallic ornamentation, such as fancy-headed nails around the edge. An ordinary steamer chair is also exceedingly useful when one is treating a feeble patient who finds an erect position tiresome.

To obtain effects which are both pleasant and beneficial, a certain degree of care and experience is required, for, unless properly administered and with due regard to circumstances, static electricity is liable to prove disappointing. It may even be made exceedingly disagreeable; nay, it may be intolerable in the hands of a careless bungler. A great part of the expressions of appreciation, pleasure, and satisfaction elicited from patients is due to the judicious use of the various electrodes. On this account I shall describe more fully certain features of practical importance.

General Electrification.—This has variously been termed insulation, the static bath, etc. But the term I here adopt seems more appropriate. It is a mild but efficient tonic, having somewhat the twofold action common to all forms of electricity, according to whether the positive or negative pole is actively employed.

When applied with the positive pole, it is a refreshing, grateful, and most agreeable tonic in all debilitated or negative states of the system—those neurasthenic, anæmic, malarious, cachectic conditions in which the patient is "below par." For the after-effects of the "grippe," for brain fag in professional

men, for physical, mental, or nervous exhaustion it is in the nature of a specific. The mildness of the treatment by the positive static charge, its facility of administration, its well-nigh universal applicability to every age and to every possible condition of disease, attach to it a peculiar importance which is worthy of our fullest consideration. It is in fact an artificial positive electrification of the atmosphere.

No one can doubt that the natural electrical conditions of the air we breathe influence health. Scientists assert that all atmospheric states which have been observed to have an unfavorable influence upon health are accompanied by an increase of negative electricity in the air. It is well known that before a thunder-storm an indescribable sense of malaise and oppression is felt by many individuals, and especially by those of a delicate nervous temperament or subject to rheumatism, neuralgia, etc. At such a time the atmosphere in the neighborhood of the earth is surcharged negatively, and the common expression that a thunder-storm clears the air is scientifically correct; the equilibrium of the two forces of electricity being restored by the exchange in the visible form of lightning between the lower negative and the upper positive layers of air.

The state of the electrification of human beings in normal health is almost invariably found to be positive. Many of the good results derived from static electricity during its flourishing period in the eighteenth century, when it seemed to perform almost miraculous cures, probably were due as much to the positive electrification as to the now obsolete "shocks," which were then deemed necessary, since Ramsden's machine, which was introduced in 1760, and for long afterward was in common use, would administer only a positive charge when applied in the ordinary way. The positive charge is therefore of primary significance in general debilitated conditions from infancy to old age, whether the results of exhausting illness or drain upon the system, or overwork, anxiety, excessive lactation, suppuration, impaired nutrition, social dissipation, functional derange-

ments, or mental states such as hysteria, melancholia, hypochondriasis, nervous insomnia, etc. In regard to its influence upon malaria Dr. Maddock observes:

In my experience I know of no more valuable feature of static electricity than its power to help eliminate malarious conditions from the system. It has been universally admitted by scientists that in malarial districts the air is electrified negatively. Following out this thought, I reasoned that owing to the greater conductivity of the air, due to moisture, people residing in paludal districts were deprived of an adequate supply of positive electricity. Acting upon this, I have for years employed the static machine by positive insulation in every case of suspected malarial origin, and the results have surprised myself. At times, before I obtained my present machine, I was, owing to atmospheric influences rendering the generation of electricity in any sufficient quantity impossible, tempted to abandon this form of treatment, but in over a year and a half I have never been disappointed in getting quantity and quality to meet all demands.

When a person is simply "run down," "overworked," and "completely fagged out," but unable to leave business and seek a change of climate, our daily experience confirms the belief that the alterative and stimulating effect of electrification embodies the potential benefit of a climatic change, sea voyage, and rest; and it may be remarked that the atmosphere surrounding a patient seated upon the insulating platform of a static machine is richly charged with ozone, which the electrical action rapidly generates, and which, inhaled by the patient during treatment, no doubt contributes to the beneficial results.

Negative electrification is applied in the same manner, but from the negative pole.

The principle of "localized electrization," established by Duchenne, who sought to cure disease by local treatment, has had an overshadowing influence upon electro-therapeutics since his day; but while recognizing the value of the local method, and utilizing to the fullest extent the advantages of its specific application, the static method goes farther, and has for its basic principles a general constitutional influence, upon which the local effect is simply grafted.

The entire administration of static electricity is first, last, and all the time a general systemic impression upon the entire organism, the vital functions, and excretions; furnishing during every form of treatment an elementary and continuous impression upon he nutrition of the individual, which seeks to promote the highest degree of constitutional vitality and to increase the tissue resistance against disease germs and unhealthy surroundings. This grand foundation benefit is inseparable from the therapeutics of static electricity, and therefore underlies the application of every form of local treatment, and may be considered as adding to the importance of all local treatments which are administered to the patient.

The Therapeutic Choice of Poles.—Almost every physician just commencing his experience with the static machine is greatly puzzled about the choice of poles. The difference is one of comparative voltage only. The fine discriminations some attempt to make in reporting their clinical results simply result from lack of information on the subject. One pole can be made to do just about all that the other can do if the operator is sufficiently expert; but differences in sensory effects are most manifest in local applications when the higher-potential current encounters resistances or attractions. This leads those who do not comprehend the state of the case to say that it is more "stimulating."

The discussion of polarity was practically settled one hundred and twenty years ago, but when it revived again in recent times it assumed about the following theoretical aspect:

"That we are every day bathed in an atmospheric electric bath is scientifically established. Prof. Elihu Thompson demonstrates that as we rise from the earth's surface to different altitudes, there appears to be a gradual increase of potential with respect to the ground, so that at one thousand feet there may be ten thousand volts difference between the air at the top and at the surface; and this difference may increase as we reach higher altitudes.

"In low, damp, malarial regions it is found that the atmosphere is electrified negatively, while the higher we go the more positive does the atmosphere become. Dry, clear, cool, sunny, rarefied, high (positive) altitudes are recognized as a stimulating combination of climatic attributes, which we would select for a large class of invalids, including those of phthisical tendencies, and as a tonic and restorative for persons suffering from overwork in business or professional pursuits, and who have no real organic disease. Accordingly, we should select also for these patients the positive pole for general static treat ment, save when exceptional indications suggest otherwise.

"On the contrary, a humid, equable, warm, cloudy sea-level, and sedative climate, or again the calm, sedative, yet tonic atmosphere of the pine woods, would be selected for other cases, and especially in certain hyperexcitable states of the nervous system. Here we might administer negative electrification.

"There is another not unimportant thought in connection with this idea, which relates not so much to the character of a climate as to the influence and effect of a *change* of climate; and, to a certain extent, this can be effected by static (positive or negative) electrification. Though we can scarcely affirm that a change of climate is a specific remedy for any disease, yet the benefit which it frequently produces, in assisting the reparative powers of nature, is a matter of world-wide observation. Change of climate, however, is an exceedingly relative phrase, and need not necessarily involve an expensive and difficult journey, with the deprivation of accustomed comforts and a residence among entire strangers. Dr. E. I. Sparks well says 'that a few-mile journey from the town to the country, from inland to the seashore, from the plain to the mountain, often suffices to produce marked results.'

"But while it is impossible for every one to travel in search of health, we have a means in the static machine of providing something of that element of contrast in the daily electrical and

atmospheric environment of the individual which is the great incentive to a journey."

These remarks about static polarity are entirely theoretical and have been made before. In practice I ignore theory and am guided by experience and necessity. The two poles represent chiefly a higher and a lower voltage of the same current action rather than opposite currents.

The chemical difference of galvanic polar action does not of course exist in the case of static electricity, and as a matter of fact I consider it settled that the result to the patient in increase of weight, regulation of temperature and heart action, composure of the nervous system, increase of urea and diminution of uric acid, and other general nutritional benefits, does not vary a great deal in the use of either pole.

I insulate the patient positively, as a general rule, in all cases of simple electrification for sedative-tonic effects, unless I am treating for the first time a new and timid patient whose wearing apparel might be "irritating," and whom I wish to introduce to the machine in such a manner as to avoid the most remote possibility of alarm.

I insulate all patients negatively for the purpose of giving a mild positive spark. If I am dealing with sluggish, insensitive, and thickened tissues, requiring the most vigorous and stimulating spark that can be applied, without the regard to comfort which sensitive tissues would require, I change the electrification to the high potential. I insulate all patients negatively for an ordinary mild positive breeze effect, and only change to positive electrification and negative breeze when a counter-irritant effect is desired.

With smaller apparatus, however, and non-metallic connection between patient and machine the results which I thus secure cannot be duplicated with negative electrification, because the current is not powerful enough. The operator, however, can substitute positive electrification when it is necessary.

The static breeze reverses the order of the preceding. The

positive breeze is bland, sedative, and agreeable, while the negative breeze may be made irritant. The fact that negative low-potential electrification is employed in administering the positive breeze accounts entirely for its softer and soothing qualities.

Both forms of breeze are analgesic and will relieve many varieties of pain. The positive is peculiarly grateful and effective in neuralgias, in local inflammatory lesions, in congestive and nervous headaches, nervous insomnia, and irritability. It will rapidly remove almost any nerve or muscle pain not due to structural change, and I have found it equally efficacious for a toothache and an aching bunion.

The grounded electrode with positive electrification yields a remarkably useful breeze, and one which will answer for many purposes. The breeze (a convective discharge) will not produce a muscular contraction, while the spark (a disruptive discharge) will; hence nothing can take the place of some form of spark in affecting muscle function, promoting absorption, etc., but I have occasionally removed very severe sciatic pains with the breeze alone, and if applied in its irritant form, like a hot spray, it is effective in muscular rheumatism and conditions requiring a powerful rubefacient and counter-irritant. Thus it is a superb cutaneous stimulant, will rapidly draw out rheumatic pains, ease a lame back, warm cold extremities, quiet a grumbling ovary, relieve the pains of a congested liver, remove nausea from a dyspeptic stomach. It imparts a long-lasting buoyant glow to the spine, is a most exhilarating tonic, reddens the skin, and leaves a sensation of lightness and warmth behind.

Either the negative or positive breeze, upon a bare surface, is cool, comforting to heated states, has no rubefacient or irritating effects, and is particularly tranquillizing upon the head and spine when no resistance interposes.

The most soothing application is the positive breeze. With this the electrode may be held quite near any part of the body. It easily gives off a spark and may startle the patient unex-

pectedly. It does not tend to irritate, but it involves a negative insulation which is often less effective than the positive.

The positive breeze may be applied to the head, spine, or any part of the body with very little fear of irritating the patient. Not so the negative breeze with positive insulation, attaching the electrode either to the negative pole or to the gas fixture. Upon covered surfaces it is prickling (and through some fabrics unpleasant) if the electrode is held motionless. To be agreeable it requires to be kept moving. A negative head breeze can be given with the standard if the patient is bald, but if hair abounds upon the head, or if applied to any clothed surface, the electrode must not only be removed to a distance—twelve to twenty inches or more—but the breeze should be kept in gentle motion to avoid an annoying prickling in certain spots.

The thickness and quantity of the hair may make it difficult to give this form of breeze from a stationary electrode, although the patient may sway the head from side to side to suit his or her sensations. Upon the head also, a lady's hairpins, if metallic, may play havoc with our efforts to please, and it is the writer's custom to substitute vulcanite hairpins before commencing treatment. Occasionally metallic ornaments about the neck will cause discomfort, and should be protected, removed, or avoided by the operator. About the spine and abdomen steel buckles, buttons, and corset ribs may be an interference with both breeze and sparks. In a general way it is also better to have a patient lay aside keys, watch, eyeglasses, etc., if local applications are to be made in their vicinity; but in most cases the tact of the operator will sufficiently avoid these sources of discomfort; and it is better, if possible, to request few changes in a patient's garments. It is rarely necessary, and the trouble of taking off her corsets for treatment will not increase the popularity of static electricity with a fashionably attired lady.

But all our care in administering the breeze is not dependent upon hidden corset steels and metal hairpins. If the coat or

dress waist be of silk or cotton fabric, the best effect is obtained with the electrode almost as near as the current strength permits without a spark, gently sweeping the electrode over the region treated and drawing it away with such manipulations as experience discovers to suit the particular case in hand. If, however, the fabric is of wool, the sensation produced may be unpleasant. If tightly woven and thick, the breeze will perhaps be scarcely felt, and must be applied correspondingly near. If the woollen garment be of loose texture, it may be difficult to find any distance at which the electrode may be held to make the negative breeze agreeable to the patient. Certain desired effects may, however, be had by rapidly sweeping the electrode to and fro, and the prickling may be modified in various ways, such as covering the part with a handkerchief or towel, diminishing the speed of the machine, or by leaking off part of the current supply. When negative irritates use positive.

An exceedingly mild and exquisite breeze may be obtained, when exceptional conditions call for the utmost refinement in our measures, by simply holding a finely pointed electrode in the hand without grounding it in any other way. It should be grasped by the operator upon the metallic part without opposing any of the insulating rubber handle, and, when moved with gentle passes near the patient's head or spine, the breeze imparted is of the mildest nature.

Many times the reverse is desired, and we wish to increase the intensity of the breeze. This may be done by quickening the machine, by having the patient in direct connection with the positive pole, by placing a layer of flannel cloth over the part, if it is covered with a less resisting substance; but most of all, the activity and force of the breeze may be increased, while its irritation is often diminished, by interrupting the current by the author's method, as elsewhere described.

On the whole the breeze application is susceptible of great variety, and if skilfully handled, with due tact and prudence, it will do more than any other form of electrical application to es-

tablish a large and gratified clientèle. If the physician who wishes to excel in technique will seat himself upon the platform and personally test the sensations which the spray electrode will produce under the different conditions we have referred to, it will be time well spent and money saved; for a disagreeable shower of "pins and needles" may lose a new and nervous patient as readily as a luckless spark.

The static spark requires to be somewhat sparingly and prudently administered. Its redeeming feature is its tremendous power for good. If the suggestions here made are followed, it will be disarmed of its drawbacks and will be a most potent influence in contributing to the great sum of results attributable to static electricity. All cases do not require sparks, and when sparks are especially indicated, mild ones may often serve the purpose.

To apply sparks, we have the patient insulated as before and continuing to be electrified; either positively or negatively, as the case may be. Ordinarily we have the negative pole attached to the platform, and apply positive sparks.

The spark is given with a spherical electrode usually, although any metallic electrode will give off some kind of a spark, if it is placed in a position to do so. The round extremity of the electrode may be of various sizes, and the thickness of the spark will be partly dependent upon the surface area of the ball. We take the largest one—say two inches and a half in diameter—attach it to the grounding gas fixture by the chain we have already used in employing the breeze electrode, and explain to our patient what is coming. Never apply a spark without first telling the patient to expect it. It is rarely advisable to administer sparks at a first sitting if the patient is a stranger. After several treatments the system acquires a degree of tolerance, especially after confidence has been established by the tact and skill of the operator.

If the patient is an acquaintance, a brief explanation may suffice to prepare him or her for any form of application that

may be desired, but it is my custom to show all nervous patients who have never had sparks exactly what they are, tell them how they feel, and obtain their confidence before administering this treatment. I then slow down the machine, if necessary, leak off part of the current force with my foot against the platform, and deliver a single mild spark upon a part where it will be well borne, usually the fleshy part of the middle thigh or upon the spine. This done, the patient's uncertainty and dread are ended. She has felt just what the spark is, and seldom offers any further objection.

Not always is the spark found to be disagreeable. A surprising number of patients will claim to really enjoy mild and skilfully directed sparks. Cases will be met in practice in which, indeed, the spark is the most welcome form of treatment. The torpid tissues of an œdematous limb may be so insensible to stimulation that the heaviest sparks that can be obtained from an ordinary machine are calmly witnessed by the patient, who regards the blows with manifest indifference; and in morbid states of sluggish natures and lymphatic temperament, the sparks will seldom cause any objection.

If the long spark is discovered to be painful and distressing, it is well to be very sure that it is indicated before giving it. It is generally found to be most bearable, most welcome, and most beneficial where it is most truly indicated; and, on the contrary, it is least tolerable when least required, though there are exceptions to this rule. A toleration also is often speedily developed.

Once across the Rubicon with a new patient, the strength and vigor of sparks, which have always at first been mild, may be adjusted to fit the case; but let the accession of vigor be imparted gradually. Sparks should be no heavier than needed to do the work. They should first be tested in a mild form before resorting to the most powerful that can be given. They should be clean, thick, distinct, and single, with both an interval of time and a "change of base" between every one

administered. A rapid fusillade of sparks is often unpleasant. A number upon the same spot is apt to create a tenderness. A long, thin spark is usually stinging, while a thick one is less so. If the spark "splits" and gives off fragments, seek the cause and correct it, for such a spark produces an uncomfortable sensation.

About the throat and various parts of the body it is often desirable to accurately localize the spark, while attracting promontories near by render this difficult to accomplish. A spark director is made for such a purpose, but it is expensive. An insulated piece of vulcanite, or even of wood, pierced in the centre for the passage of the spark, is also occasionally employed. These devices, however, are seldom an absolute necessity. There is scarcely a spot upon the exterior of the body where a spark may not be exactly placed by drawing aside the adjacent parts, slowing the machine, and sending the ordinary electrode to the spot with a quick, sharp stroke. A nearby prominent part may be protected also by laying over it a folded paper, or something to obstruct and lessen its attraction.

Having a case for powerful sparks in hand, we may now increase the effect in several ways. Putting the machine into more rapid action is usually sufficient in favorable seasons. If more than this is required, we may again make direct metallic connection between the patient and the machine. The conducting rod or chain may be held in both hands or placed under both feet. Caution will be advisable if this is done, for the first result may surpass our expectations. If this proves less powerful than is desired, however, as may be the case in damp and summer weather, a pair of small Leyden jars may be brought into the circuit. Still greater caution should now be displayed, and the spark tested before applying to the patient. The smallest jars may be tolerated usually, but the larger jars overdo the matter, and the largest size should never be employed unless for good and well-understood reasons, and by an experienced physician, between whom and the patient there is entire confidence.

Sparks may be administered, as may also the breeze, while the patient is electrified with either the positive or negative pole; and with the electrode attached to either pole, or to the ground.

When we desire a muscular contraction, without the sting which is more or less inseparable from a spark directly upon the patient, the author's method of interrupting the current is of use. The part is bared sufficiently to apply an electrode directly upon the skin, and, in turn, over the motor points of the faulty muscles. The electrode is attached by a chain to one pole of the machine. The other pole is grounded, and with a grounded ball electrode sparks are slowly applied to the pole to which the patient is connected.

Another way—and one equally available—consists in holding a small ball electrode upon the spinal motor points while the machine is adjusted as in ordinary positive electrification. With a grounded ball electrode, sparks are then applied to the metal part of the electrode held in contact with the patient, but at a distance from the ball, which presses upon the motor point of the muscles.

The contraction which follows is painless and effective. In this way an unlimited number of sparks may be applied to any given point without creating tenderness, as do repeated sparks upon a single place upon the body. Moreover, the strength and frequency can thus be so regulated as to produce effects reaching from slow, single, deep contractions to the infinitely rapid, sedative quality of the high-tension faradic coil.

Air spaces under folds in the apparel interfere with sparks and should be removed by drawing the garment to a smooth fit. Damp clothing will interfere also, and some fabrics facilitate the application more than others. A steel buckle, a bunch of keys, metal buttons, ribs and steel springs in waists and corsets will attract the spark and produce too sharp a sensation for comfort in some cases.

In static administrations there must be two objects kept

in view. One is to produce benefit to the patient; the other is to avoid all possible annoyance. It is always desirable to strive to make the treatment as agreeable as possible, and this is generally as important a factor as the constitutional effect of the treatment, for the two results will proceed better in double harness than if the patient thinks the cure as bad as the disease.

Considered as a mere luxury and apart from remedial effects, no other form of medical treatment is capable of imparting the sense of satisfaction which can be obtained from certain forms of static electricity. Unless the effect of a counter-irritant is especially desired, the breeze should be as agreeable around the head and spine as the soothing manipulations of a dexterous hair-dresser. If sparks are applied with conservative caution until tolerance develops in the tissues, there will be very little complaint. Slowly repeated, clean-cut sparks will be readily endured even by hypersensitive neurasthenic cases. Never treat a new patient to a fusillade of sparks at a first sitting.

There are certain anatomical localities which are usually to be avoided. In a genera way the head should be omitted from spark treatment, though to this rule, as well as to most others, there are exceptions, and modified sparks are frequently applied to special portions of the head with great benefit.

The breast, both in male and female, and particularly the nipple, is sensitive; in many cases extremely so, and should not be struck with a spark except for sufficient cause. Bony prominences throughout the body are regions where caution is advisable, there being no pillow of soft tissue to break the blow. A spark on the dorsal surface of the foot or hand, and especially over a toe or finger-nail, is more uncomfortable than many patients would admire unless the conditions are altered by disease, as they would be in a case of chronic synovitis, or localized œdema.

The testicles, most of all, must be avoided. The sickening sensation caused by a spark in this peculiarly sensitive region would have no other excuse than bungling carelessness.

Besides the ordinary and single, thick percussion spark, which has hitherto been the subject of our consideration, there is a form of "friction" spark which has certain uses. It may be obtained in several ways. The ball electrode may be enveloped in a flannel covering and rapidly rubbed over the surface, if applied directly to the skin. Upon the covered body the same effect is furnished by the resistance of the garments worn, especially if of wool. It is quickly applied, and exceedingly valuable in myalgias and as a cutaneous stimulant.

One of the most effective methods, also, and one often employed by the author, is secured by rapidly interrupting the current and using the spray electrode. The *technique* is as follows: Let the patient hold the conducting rod above or below the sliding positive pole of the machine so as to draw a series of rapid sparks of a length to suit the conditions of the case. The point electrode is then grounded or connected with the opposite pole, and rapidly swept over the affected part at the distance which is found to produce the proper effect. As the electrode approaches nearer the spine or limb to which it is applied, the breeze will merge into a brush discharge, and still nearer this will become filled with jets of fine, flying electrified particles of air—a veritable electric spray! Stronger sparks will occasionally be interspersed with the finer jets, if the electrode is swept still nearer, and the administration partakes of the nature of a powerful and stimulating tonic. Its intensity is, however, under complete control, and may be regulated to a proper degree. Friction sparks are heating and counter-irritant as usually applied.

The static spark is the most energetic of the various forms of electrical discharge, and is also the most powerful therapeutic application of static electricity. It excites strong muscular contractions and produces a widespread mechanical disturbance in the tissues to which it is applied, causing active molecular change and exerting an extensive influence upon both local and general nutrition. The short, fine friction sparks obtained by

simply rubbing the ball electrode over the surface of the patient in contact with the ordinary garments worn are indicated chiefly in cases of altered peripheral sensations, anæsthesias, myalgias, etc., but this stimulation of the terminal nerve filaments is carried to the central cells and produces deep and lasting effects. Frictions can thus produce rapidly, in a few moments of application to the entire body and without removing any clothes, an effect of counter-irritation and reflex stimulation.

It is, however, the long and strong, thick spark which is the most effective weapon in skilful hands. Its range of action is wide, and if carefully employed in varying degrees of strength, its power for good may be called into requisition in the majority of cases demanding static treatment.

It is this spark which restores tonicity to enfeebled or paralyzed muscles, softens indurations, resolves exudations, breaks down adhesions, and promotes absorption; stimulates nutrition and the functions of the central nerve cells; drives out hysteria, banishes rheumatism, gout, and malaria from the system; conquers sciatica and neuralgias of almost every form, relaxes contractured muscles and tendons, and subdues some of the most furious pains. It is the great alterative and regulator of nerve and muscle functions and functions of the visceral organs.

It is the tonic *par excellence*, deep-acting and far-reaching in its effects. It requires, however, to be employed with discretion and with a reasonable degree of tact and skill.

Potential alternation is the author's method of interrupting the ordinary static current. A description of this method was first published in the *Medical Times and Register*, September 9th, 1893, under the title of "A New Static Interrupted Current; a New System of Therapeutic Administration of Static Electricity Based upon the Principle of Potential Alternation."

From this article the following extracts are quoted:

I have for some time employed with satisfaction to my patients and myself a new method of applying static electricity, of which I have seen no account hitherto published.

In the method which I shall now describe no change is made in the adjustment of the machine or in the patient's clothing. The patient is seated upon the platform, and after being charged in the usual manner, his potential is suddenly reduced to zero by the approximation of an interrupter to the conducting rod. A succession of alternations between a high and zero potential may now be maintained as rapidly or slowly as desired.

The interruptions may be regulated at will from one in any number of seconds to any number per second, and by fixing the interrupter on a standard the application becomes automatic and does not require the operator's constant attention.

Whatever of therapeutic value is imparted to galvanic and faradic currents by "interruption" must also be imparted to the static current; and the speed of the interruption of the static current can, by my method, be made to cover a greater range than any faradic vibrator yet invented. When administered merely for its general nutritional effect, it is exceedingly suggestive to note the visible oscillations of the patient's hair, to feel the vibratory commotion in the surrounding atmosphere, and to consider the molecular disturbance and alteration of nutrition which must be going on in every part of the electrified body.

And this alterative commotion among the tissue cells, quickening the protoplasmic activity, is carried on so mildly that the patient is conscious only of the gentle vibratory breeze. As regards local applications to give muscles work and stimulate contractions, I have found this method of practical service.

It is evident from a mere glance at the extremely limited variety of static applications and the limitations of each, that a new method of practical simplicity and extensive therapeutic range is a desirable contribution to static treatment. It can be applied to the whole or any part of the body without change in either machine or patient, and employs the electrodes in common use. A careful review of such records as have been available does not disclose any reference to any similar system of applying static electricity.

While a number of ingenious devices might be contrived to be employed in the use of this method, it will usually be sufficient to utilize the ball, point, and roller electrodes. These, with the rod, a chain, a foot-plate, and a standard, will enable the operator to obtain about all the effects he may desire. The ball electrode is used as an interrupter, drawing sparks from the prime conductor instead of from the patient. If the roller is attached by a chain to the machine, it may be applied by the operator to

any or all muscles in turn, and rapid or slow, mild or very powerful, but painless contractions may be set up. If the patient's feet are placed on a metal plate or in a foot-bath and metallic contact is made with the machine, a negative breeze electrode placed at a proper distance above the head, while the ball electrode, grounded and fixed on the standard, is adjusted so as to draw a succession of long sparks from the positive prime conductor, a tonic and alterative effect upon circulation and nutrition will be obtained that is exceedingly beneficial in cases of disturbed equilibrium of the vital functions.

As a means of giving exercise to the arms, there is no other method superior to potential alternation. Simply wind the chain around the forearm (bare) and proceed to interrupt the current. Every muscle will be brought into play, more or less, according to situation of the contact. If held in the hand, or if the hand is immersed in a bath, an effect extending up the entire arm may be produced.

I have noted in cases exercised in this manner that the muscles not only become firm and play under the skin with remarkable facility, but that the skin itself becomes tanned as if from exposure to outdoor sun and air. I have never seen this effect produced by direct sparks upon the person, but have witnessed it repeatedly in cases treated by potential alternation. The pallor of persons confined to the house by protracted illness is thus removed very rapidly and replaced by a healthy color, even though they continue to remain indoors.

Much more could be written upon this subject, but no treatise, however complete, can take the place of experience. In order to operate a static machine with satisfaction and with good results, it is necessary that the physician should not only acquire facility in the technique of handling the machine, but he must also know how to inspire confidence in the patient, and at all times exercise the care and minute attention to the details of his treatment that are essential to success in all forms of electrotherapy.

In static applications there are but two chief forms of the kinetic energy to consider. One is the direct flow along the prime conductors; the other is the flow through Leyden-jar condensers. It will be noted that my system involves all methods of interrupting the direct static current. In my method the manner of the potential alternation is immaterial as relates to the principle of action, and is important only as it modifies the effect. For instance, the interruption may be made with the sliding poles the same as is now done in the case of Leyden-jar currents; but I do not recommend this manner, for the reason that the control of the rate of interruption as well as of the dose is far less satisfactory than when the electrode is used, as I have described. Moreover, as demonstrations of the high potential energy of either interrupted static current, a perceptible effect may be obtained from the application of a single electrode whether the second pole is grounded or included in the circuit or not; but to obtain full therapeutic usefulness it will be well to adhere closely to the methods recognized as most effective in actual practice.

In carelessly or ignorantly employing galvanic or even in some degree faradic currents, there is a well-known possibility of doing harm. This liability is reduced to a minimum in the case of static applications; nevertheless, a patient may be startled by careless sparks or any accidental derangement of the administration. In avoiding needless causes of alarm to the patient the physician will do much to build up his success with static electricity.

Useful Hints.—Having had frequent occasion to observe the difficulties which beset the novice in acquiring familiarity with static technique, the author ventures, even at the risk of being considered elementary, to insert at this point a few practical reminders. Physicians who do not need these suggestions may pass them by, but to not a few readers they will possess a timely interest and real value. Of course no experienced operator requires any instruction of this kind,

but others of less experience or none at all will probably be glad to receive any aid to the satisfactory use of the static machine.

Don't neglect proper care of the machine.

Don't expose it to damp draughts.

Don't operate it in too small a room.

Don't place the platform and patient too near the machine or gas fixture.

Don't place objects of furniture so near that they will attract the current from your patient.

Don't stand so near the patient yourself that you will do the same.

Don't allow an electrified patient to touch objects or shake hands with a visitor.

Don't pass so near your electrified patient while directing treatment that you will draw an unexpected spark and startle your patient unnecessarily.

Don't incautiously handle a charged Leyden jar.

Don't seat a patient for treatment on a chair that contains ornamental brass-headed nails in its upholstery.

Don't fail to remember corset steels, wire hairpins, lace pins, buckles, metallic trimming, etc., in directing local applications to neurasthenics.

Don't forget that thickness, dryness, and quantity of a patient's hair will affect the intensity of all applications about the head.

Don't forget that fit, material, texture, and thickness of garments directly influence some forms of static applications, which must be modified accordingly.

Don't forget that static sparks are not always popular, and remember that you have a patient to treat as well as a pathological condition.

Don't forget to ground the electrode.

Don't start the induced current into action with the sliding poles drawn wide apart.

Don't fail to see that the machine is charged and in working order before you call your patient for treatment.

Don't forget to ground the indifferent pole.

From time to time a physician to whom I am giving clinical instruction in the uses of static electricity will refer to some minor variation of method he has perhaps read about elsewhere and ask me why I do not do the same thing. I never argue about such a question but demonstrate both methods and let him take his choice. Static electricity will not perform equally well in all cases when routine methods of any kind are employed in an unvarying way. I am not wedded to any hobbies and at all times approve of the best means which will produce the best results.

CHAPTER VI.

HOW TO REGULATE THE STRENGTH OF A STATIC APPLICATION.

Position of rod upon the platform. How to increase current strength to any desired degree. Direct metallic conduction important. How to intensify local applications of breeze, spray, and spark. Dose regulations of Leyden-jar current.

THE dosage of static currents in general electrification with either pole is affected by the following:

1. Rate of revolution of plates from very slow to very fast, the activity of current output being in proportion to their speed.

2. Good or bad conduction of the current from the machine to the patient, and the insulating capacity of the platform.

3. Attraction of the current away from the patient during electrification.

4. Reinforcement of direct current by Leyden-jar condensers.

5. General atmospheric and physical conditions of the machine and the office.

6. Operative skill of the physician.

The means at our command to modify, increase, or decrease the strength of treatment, and regulate its force to suit the varying requirements of disease, are complete and adequate in the case of static electricity without employing either a meter or a rheostat, such as are necessary with galvanic currents. No such instruments are made for use with the platform applications of static electricity and we would not need them if they were.

With the patient in position for treatment the poorest method of connecting the pole of the machine with the patient consists

in resting the lower extremity of the brass rod upon the corner of the platform surface most distant from the person's feet.

A great deal of resistance must be overcome before the current reaches the patient, and the great difference of potential between the prime conductor and the patient, when both should be alike, is detected by requesting him to touch the rod with the hand and note that a spark will pass. It is obvious that by this manner of placing the rod the patient will receive a very weak current and only a small part of the actual output of the machine.

The weakest output of the machine is obtained by the slowest revolution of the plates. Stronger electrification will be secured by pushing the end of the rod nearer the patient's feet and making the plates turn faster. No wooden platform surface is, however, a very good conductor. In damp, sultry July and August weather the atmospheric leakage of the current may be more rapid than the conduction over the platform to the patient. The insulating resistance of the air is diminished by the dampness, and a good spark is then difficult to obtain. If increasing the machine activity does not sufficiently increase the patient's electrification, we must better the means of getting the current into him. The best that can be accomplished in this direction will be done by cutting out all bad conducting material between the prime conductor and patient and substituting metal.

Have the patient hold the brass rod in the hands, if this does not interfere with any desired local application, otherwise put a metal tray under the patient's feet and let the rod rest upon the platform as usual, but connect it with the foot-plate by a brass chain. At all times of the year this method of metallic contact will produce the most vigorous electrification with a given rate of the machine. In winter time it will enable the operator to obtain a maximum current without a maximum speed. In the summer time it is a necessity anyway.

If still further means of increasing the current strength are

required on a summer day, the machine can be dried more thoroughly with freshly baked chloride of calcium, the office may be closed, and a grate fire or a few gas jets be kept burning for a short time to dry the atmosphere, and the small or even the largest Leyden jars may be attached to the prime conductors and their outer coating connected.

With these precautions almost any form of desired treatment can be given during the worst season of the year. No one, however, should employ the Leyden jars until he is well trained in the use of static electricity, for a patient would be exceedingly unlikely to call again if an accident happened through the operator's want of skill, although the accident would be harmless.

To add strength to local applications of the breeze, spray, and frictional spark, we may have the patient hold the brass rod so that the upper end will not be in direct contact with the sliding pole but will rest about three-quarters of an inch away, and a spark stream of this length will intensify the velocity of the flow.

By some modification of these measures every practical increase in the vigor of any form of application may be regulated with exactness, and to weaken the administration if it is too strong these steps may be reversed.

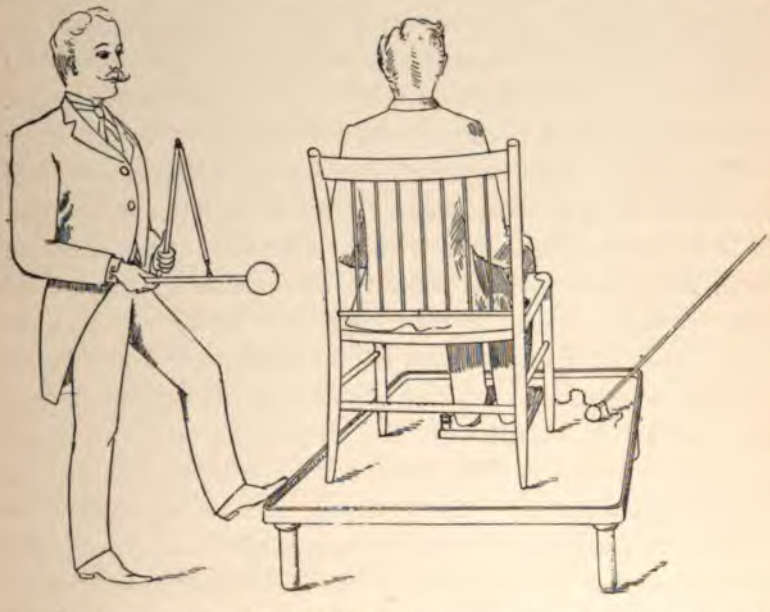
The spark can be modified in length, thickness, and strength by (1) leaking off parts of the current through the operator's foot, placed for the moment upon the edge of the platform; (2) by turning the machine more slowly; (3) by removing direct metallic conduction and placing the brass rod directly upon the wooden platform and (4) farther away from the patient's feet.

A very mild breeze or spray application may be made by simply holding the metallic part of the electrode in the hands instead of giving it metallic conduction to the earth.

A mild spark can be given in the same way, but causes a contraction in the operator's wrist.

It should be noted that in any continuous electrification or breeze application, the direct metallic connection with either

the hands or feet of the patient produces no sensation whatever. The moment the current is interrupted by any form of spark discharge the patient must be protected from annoyance by the operator. A strong spark given with positive electrification and the rod held in the hand will cause an annoying contraction at the wrist; but with both hands in contact with the



The above diagram shows the foot resting upon the edge of the platform to leak off the current when it is desired to apply a very mild spark or breeze. It is a temporary expedient which at some time is employed in the treatment of the majority of cases.

rod and negative electrification, an ordinary positive spark may be given with comfort. If shoes are thick-soled, and are filled with nails in either the sole or heel, sparks may sometimes annoy a patient whose feet rest upon the metal tray. With ordinary shoes this does not occur.

The dosage of Leyden-jar currents is regulated by the size of the jar (small, medium, or large), by the distance between the sliding poles, and by the rapidity of the revolving plates. The

nearest equivalent to a high-tension induction-coil current is obtained from the smallest jars, with the plates revolved very fast to simulate the rapid vibrator, and very slowly to simulate the slowly interrupted faradic current. Extremely rapid rates are best obtained by the use of motor power to operate the static machine. Slow rates of from fifty to one hundred and fifty interruptions per minute for muscular contractions are best obtained when the machine is controlled by hand.

The medium jars resemble somewhat the medium secondary induction coils as respects quantity of current, while the largest jars may be said to resemble the shortest coarse-wire secondary coil. The difference between these jars is a prolific source of argument between those whose electro-therapeutic information is in an embryonic state. Some say that the current from the large jars "causes painful muscular contractions," etc.; but, as a matter of fact, an intelligent regulation of the distance between the poles and the speed of the revolving plates will enable the operator to secure his desired effects with all Leyden-jar currents without any necessity of causing pain with any size of jar.

By regulating, therefore, the manner in which the patient receives the current from the static machine—whether by direct metallic conduction or through a greater or less intervening gap of air or wooden surface—by regulating the rapidity with which the plates revolve, and by graduating the management of the different electrodes to suit each case, the current can be made as gentle or vigorous as desired.

In a hot, dry room on a crisp winter day, or in a damp room on a sultry day in summer, the knowledge of how to govern the potential and current supply at will is often an inestimable advantage. It is perhaps impossible to set down in writing all the various manœuvres by which an experienced operator consults his patient's comfort during treatment, but sufficient is said above to indicate the general ways in which the beginner may proceed, and practice will teach the rest.

CHAPTER VII.

X-RAY APPARATUS AND STATIC METHODS.

Early opinions unfavorable to static machines for X-ray uses. X-ray facilities a surgical necessity. Therapeutic apparatus preferable. A surgeon's practical experience in his daily office work. X rays establish diagnosis and avoid serious mistakes in treatment. Simplicity of essential apparatus. The usefulness of the fluoroscope to the surgeon. Clinical examples of the indispensable importance of X rays. Cases cited. Medico-legal value of the X-ray photograph for the surgeon's protection against suits for damage. A comparison between coils and the Holtz apparatus in X-ray work. Special static tubes a necessity. Reasons why ordinary tubes disappoint static operators. Advantages of the static machine over other apparatus for exciting X rays. Conclusive demonstrations of its superiority. A tube history. A five-minute negative of the trunk, with complete detail of skeleton, September 20th, 1896. Summary of objections to coils by coil manufacturers. Life of tubes. Exposure times with coil apparatus.

ABOUT the beginning of the year 1896 Prof. William Conrad Roentgen, of Würzburg, Bavaria, gave to the world his astonishing discovery of X rays.

Only the practical application of these rays to diagnosis will be considered here. Every physician has read, or can read in other works, the theoretical side of their origin and nature, and what I shall here aim to do is to assist the practitioner with information he can use in clinical ways and which will instruct him as to apparatus.

During the first months of the year 1896 the opinion prevailed that: "Thus far the only apparatus known which will produce X rays readily and profusely is the induction coil. Such a transformer gives exceedingly great electromotive forces, capable of producing discharge over long air gaps. When the discharge from such a coil is passing through *properly exhausted* and *constructed tubes*, we have a very vigorous generation of X rays."

During this same experimental period the static machine was equally known to give exceedingly great electromotive forces, capable of producing discharge over long air gaps, surpassing in these respects the capabilities of the ordinary coil.

It was tried and for the most part rejected in early X-ray work, for two wholly sufficient reasons, which demonstrated that (1) the discharge from the static machine was not then passed through tubes properly exhausted and constructed for the static current; (2) that scarcely any of the experimenters were skilled in the special manipulation of such an apparatus, and the few who were expert with static electricity could not then procure Crookes tubes adapted to its great electromotive force.

The author's paper* on "Roentgen's Contribution to Surgical Diagnosis" about this time remarked: "A powerful static machine with Leyden jars and transformer coils will do fairly good work, but far from the best."

Five months later the author was practically demonstrating to physicians in his office and clinic that when the discharge from the Holtz machine was passed through Crookes tubes, which proved to be "properly constructed and exhausted" to suit this form of current of extraordinary potential, there resulted a generation of X rays from twenty to thirty per cent more vigorous and profuse than the product of the best coil known to be then employed, from three to five times more useful to the diagnostician than the X rays of average-priced coils, and incalculably more valuable than the feeble glimmer of the coils and small tubes in most common use.

The author's great interest in the matter has not permitted him to remain uninformed of any step of progress or fresh achievement reported by other original workers in this field. Having been the first in this country to write for medical readers a presentation of Roentgen's discovery as it promised to

* Read before the Kings County Medical Society, Brooklyn, N. Y., April 21st, 1896.

affect diagnosis (January 7th, 1896), and having followed the various stages of coil and tube development to this date, the author offers the conclusions of his personal experience for the guidance and instruction of other physicians who seek facts upon the subject.

These propositions are deemed capable of demonstration: 1. No surgical consulting-room is fully equipped without an apparatus for X-ray examination. 2. The surgical practitioner will consult his own and his patients' best interests by employing an apparatus which is also of great therapeutic value. 3. The medical practitioner can most profitably utilize an electrical apparatus which is not only of prime electro-therapeutic importance but which constitutes his most practical, economical, and efficient source of X rays. 4. The physician cannot obtain satisfactory X radiance, for all-round fluoroscopic investigation and short-exposure photographs, with coils of low efficiency, and therefore, comparing effects with cost, such coils are a wasteful and nearly useless purchase. 5. The best coil of either simple or high-frequency type possesses drawbacks which will tend to eventually displace it in favor of more satisfactory apparatus. 6. The high-potential static current from therapeutic Holtz machines is superior to any coil known to be made at this date (February 24th, 1897) in respect to economy, value, efficiency, satisfaction, reliability, and almost all that pertains to the medical and surgical uses of X rays in hospital and office practice. 7. No one can doubt these facts who witnesses repeated practical demonstrations of them, and such demonstrations are easily made by a skilful operator.

These facts will probably not change within a time which can now be foreseen, for coils have not only reached a high state of development with the great advances of industrial electricity, but the transformer which has proved to be the best is the direct, old-fashioned, simple, Ruhmkorff type: Crookes tubes do not alter in principle from the best that were made five months ago, and the Holtz machine cannot recede from the high standpoint

of efficiency which it achieved before Roentgen's discovery was dreamed of.

Accordingly, the judgment of to-day, which is based upon well-digested experience, is not liable to sudden or immediate change.

The first inquiry of the medical mind will relate to whether X rays merely gratify the curious or are possessed of genuine diagnostic value commensurate with their cost and trouble. Object-lessons are more convincing than arguments, and I never fail to demonstrate the priceless value of a high-efficiency Crookes tube when the inquirer consults me in my office; but to the support of my own view, that the X ray has become a surgical necessity, I have selected from among the mass of corroborative testimony on the subject the declaration of Richardson, which sets forth the matter adequately and which is in chief part presented below.

THE PRACTICAL VALUE OF THE ROENTGEN RAY IN THE ROUTINE WORK OF SURGICAL OFFICE PRACTICE.—The object of the present communication * is to illustrate the usefulness of the Roentgen ray in the daily office work of the busy practitioner. The results which I have obtained in X-ray photography are not of course to be compared with those from elaborately and expensively equipped laboratories and hospitals, for they were all taken in connection with my routine office practice. They have been selected from a large number to show the value of skiagraphy in the every-day work of one who knows nothing about photography, nothing about electricity, and but little about physics; who, in short, knows just enough of the principles involved to enable him to place the patient, the tube, and the plate in proper position, and to turn on the current.

A further object of this paper is to show if possible that no surgical consulting-room is fully equipped without an apparatus for X-ray investigation. Doubtless the application of this device to medical diagnosis is quite as important as to surgical, but this question I leave to others more competent to judge.

In the course of the past three months I have been able not only to make accurate diagnoses in many cases in which accuracy was impossible without the X rays, but also to avoid serious mistakes

* Medical News, December 19th and 26th, 1896.

in the investigation of fractures and dislocations. I have been able to watch the growth of an osteosarcoma until, having invaded half the radius, it has destroyed the whole, to ascertain the situation and extent of the patella and other fractures, when such a knowledge was of great value and could have been acquired in no other way.

In another instance I have been surprised to see the excessive malposition of fragments which by former methods of examination seemed to be in usually good approximation. It has been possible also to detect foreign bodies in the trunk and in the extremities with a certainty which seemed extraordinary. Results thus obtained in every-day work by one so ignorant of the subject leads to the belief, already expressed, that the X-ray apparatus is indispensable to the consulting-room; that it is as essential to the surgeon as the mirror to the laryngologist or the stethoscope to the general practitioner.

The cumbersome and expensive apparatus of the laboratory, of the hospital, or of the expert seems unnecessary in connection with every-day skiagraphy—as unnecessary as a knowledge of cathodes and anodes, of poles and coils. The technique of skiagraphy, like that of the telephone and phonograph, should be of the simplest kind, and should require only the most elementary knowledge.* Not that a knowledge of, and taste for, electricity and physics is useless, but for the general application of skiagraphy such knowledge and aptitude is not necessary.

The essentials, therefore, of an X-ray apparatus for general office work, both in fluoroscopy and in photography, are (1) simplicity and (2) ease and rapidity of application. It is extremely desirable that the apparatus, of whatever form, should be connected with the street electrical mains. That form of Crookes tube is of the greatest value which is not easily disarranged or broken, and which can be easily adjusted in different positions. The sole efforts of the surgeon should be directed to the adjustment of the patient and the tube, and to the use of the fluoroscope and of the photographic plate.

Impairment or complete arrest of even the simplest and best machinery must of necessity take place, from the very nature of the process—accidents which cannot be prevented even by those who are most familiar with electrical machinery. It is essential, therefore, that the apparatus should be supplied by responsible firms who are prepared when summoned to respond at once by sending expert repairers. In this respect the X-ray apparatus

* The writer has reference to a coil outfit, and the static machine is free from these objections.

should be on the same footing as the telephone, the phonograph, and the typewriter. Upon this point considerable stress should be laid, for the breaking down of an apparatus in the middle of an office hour, when perhaps appointments have been made for its use, may subject both surgeon and patient to inconvenience and annoyance.*

The methods should be capable of rapid application. Many machines require so much time for their adjustment that they cannot be recommended even if their results are superior to those of a method more speedily applied.

In many cases, particularly in examinations of the hand or the foot, a minute, or even less, is sufficient to give all the necessary information; in others, especially in examination of the thick parts —the shoulder, the knee, the trunk, for example—a longer time is necessary.

In ordinary cases of fracture, dislocation, or presence of a foreign body, the use of the fluoroscope requires not over five or ten minutes—a period of time which would be a short one for making a careful diagnosis in obscure cases under former methods of observation. I have used the ——— plate of various sizes. After an exposure of from thirty seconds to fifteen minutes, the plates are labelled, put one side, and sent when convenient to the developer.

The value of the X ray in office work is conspicuous in the detection of fractures and dislocations of the bones; in the demonstration of integrity whenever suspected fractures and dislocations do not exist; in the detection and localization of foreign bodies; in the diagnosis of growths composed wholly or in part of bone.

It has, of course, other and less important uses. Unless the surgeon has the apparatus at his elbow, this information can be obtained only by sending the patient to a hospital or to an expert; even then the surgeon must depend on an oral or a written opinion, or upon a photograph, unless he goes himself with the patient—reasons which themselves justify the assertion that every surgeon should do his own skiagraphy.

In recent fractures—chiefly of the upper extremities, the clavicle and the ribs—the exact position of the fragments before and after reduction can be made out. With the aid of an assistant a faulty adjustment may be rectified at once. Displacement of the fragments may be discovered long before the time for reapplication of the splints.

In those fractures of the lower extremities which present themselves at the office, the same information may be obtained. Indeed, an early fluoroscopic examination of every fracture may soon be

* These remarks refer to coil outfits.

required of every surgeon for the protection of the patient, and an early photograph for the protection of the surgeon.

In old fractures the information to be gained by the method under consideration is often invaluable, for only in this way can we determine the position of the fragments, the point of impingement, and the cause of impaired functions. Here, as in most X-ray work, the fluoroscope gives vastly more important information than the photograph, because one sees in succession the parts from every point of view.

Dislocation of the extremities, old and new, can never be overlooked in fluoroscopy. The slightest variation from the normal is immediately visible in an extremity, below the shoulder or the hip. Even in the shoulder an obscure dislocation can generally be detected unless the parts overlying the bone are unusually thick.

The occasional failure to detect a dislocation of the elbow—a mistake with which the most experienced are sometimes confounded—is impossible, if the surgeon as a matter of routine examines with the fluoroscope. I have overlooked a backward dislocation of both bones of the forearm during twenty weeks' constant observation—an error in which my colleague shared. *This fact alone justifies the proposition* upon which this communication is based *—that the new method of observation is one of the essentials of the every-day examination.*

In another instance, that of a man of sixty, the physician in attendance was sure that there was an unreduced dislocation of the humerus. In spite of careful and repeated examinations by the usual methods I was not absolutely convinced that the head of the bone was in its proper place until I examined the shoulder carefully with the fluoroscope from several points of view.

In united fractures, especially of the humerus and of the forearm, the situation of the bone may be detected with great ease.

In one instance the physician blamed himself, and the patient the physician, for a non-union of the humerus, when a careful examination with the fluoroscope showed that the bones were in perfect apposition. What prevented the union of the humerus it was impossible of course to say; it was nevertheless a great satisfaction to know that the non-union did not depend upon any faulty position of the fragments.

In the detection of foreign bodies the apparatus is of course indispensable. Two or more points of view are essential to determine by triangulation the exact position of the body. The demands from this source are, however, infrequent. As in other X-ray examinations the fluoroscope possesses far greater value than the photograph.

Other not infrequent uses for the X ray in general surgical practice are the demonstrations of bone diseases—exostoses, tumors, loss of substance, irregularities in contour, and variations in size.

In some instances, notably of osteosarcoma, it is possible to detect the growth in its early stage as soon as the density and contour of the bone is affected. Such a growth may be watched from week to week; the bone may be seen gradually to melt away before the invading neoplasm.

In tumors of undoubted bony origin deductions based upon density may easily be made. Exostoses, especially of the extremities, often present pictures of the greatest detail and accuracy.

Irregularities in outline from erosions, necroses, bony deposits, and in fact all forms of bone disease attended by change in form, widen still further the scope of skiagraphy. It must be borne in mind that all the investigations detailed in the foregoing paragraphs may be made in the course of the ordinary surgical examination.

The following cases have been selected from a large number, to illustrate the foregoing remarks.

CASE I.—July 14th, 1896: Mrs. A——, aged 32, sustained a fracture July 1st, of both bones of forearm. The fracture had been reduced immediately by a surgeon of great experience. By ordinary methods of examination the arm seemed in perfect condition; in fact, a more perfect approximation of fragments could hardly be imagined.

A skiagram showed the radius in good position, the ulna with a marked displacement of the lower fragment. The patient made an excellent recovery, however, without perceptible deformity or loss of function.

CASE II.—October 5th, 1896: Mrs. B——, aged 32, fractured both bones of the forearm (left) June 26th, by being thrown from a bicycle. The arm was placed in a metal splint half an hour afterward by a physician. On October 5th I found a fracture of both bones of the forearm, with considerable deformity and serious loss of function, both as to rotation and flexion of the hand. The skiagram shows the position of the bones and the amount of deformity. The fluoroscope gave me a most perfect idea of the extent and nature of the displacement. In spite of the displacement massage has considerably improved the arm.

CASE III.—October 10th, 1896: Miss G——, aged 27, fell January 10th, 1896, in the street and fractured the right patella. She was kept in bed with the usual treatment of such injuries for three months. A second fall resulted in a refracture, with excessive separation of the fragments of the patella.

The fluoroscope showed the lower fragment was directly over the articulation between the tibia and the femur, and the upper fragment was some four inches higher; that there was a third small fragment loosely attached to the lower one, and slightly separated from it. This fragment was shown to be also partly divided; it could not be detected by digital examination. The seat of injury was exposed on October 13th, 1896, and after much difficulty by cutting the tendon of the quadriceps above and below the patella, the parts were brought into position. The small fragment interfered so much with approximation that it was entirely removed. The patient has made a good recovery.

CASE IV.—October 13th, 1896: Mr. C——, aged 62, had been troubled for six years with a painful thickening of the terminal phalanges of the great toe of the right foot. Digital examination seemed to indicate a thickening of the bony parts of this toe. A skiagram showed most beautifully all the bones of the foot, but nothing could be seen indicating disease of the bone. The demonstration was very satisfactory, and solved the question of operative interference.

CASE V.—October 16th, 1896: G. B——, a boy aged 12, had been injured in the left hand, two weeks before, by a bullet from an air-gun. It was not supposed possible by the attending physician that the bullet had penetrated the palm. The fluoroscope showed plainly a small metallic object over the distal extremity of the middle metacarpal bone. A side view showed the depth of this bullet in the palm. Under cocaine the bullet was removed.

CASE VI.—October 17th, 1896: General W——, aged 59. This gentleman had had for five months a painful swelling in the right wrist. By means of the fluoroscope the ulna was seen to be intact, the radius to terminate abruptly in the faint shadow of the carpal tumor. . . . A thin shell of the radius could be seen remaining. The diagnosis of osteosarcoma of the radius, made from the history of the case and from inspection and digital examination, was practically proved by the fluoroscope and by the skiagram. A previous consultant had assured this patient that the tumor was an aneurism of the radial artery. In a second skiagram, taken a month later, the shell of bone had entirely disappeared, a fact that demonstrated the bony origin of the tumor and the rapidity of its extension. The arm was amputated, and the disease proved to be an osteosarcoma of the radius. In a precisely similar case, Mr. F——, aged 73, a tumor of the left wrist was diagnosticated beyond a doubt by the Roentgen ray. In this case, skiagraphed by an expert, the bony structure of the tumor could easily be seen. The arm was

amputated after the incision of the tumor and the microscopic demonstration of its nature.

CASE VII.—October 17th, 1896: Mr. P——, aged 27, presented himself with a fracture of the patella of three months' standing. The fluoroscope and a skiagram showed a ligamentous union of a fracture in the lower and middle thirds of the patella. It was proposed to allow the man to go about his business. The fragile union, clearly demonstrated by the X ray, alone justifies the opinion that he ought not to use the limb freely till the expiration of six months.

CASE VIII.—October 19th, 1896: Mr. J. M——, aged 60, had received from a fall a compound fracture of the left leg. The bones of the tibia and fibula had been extensively comminuted, with laceration of the skin. He was under my care at the Massachusetts General Hospital, where he remained some three months. On his discharge from the hospital the leg was perfectly straight; there was no impairment of the function of the ankle, and the union was unusually firm; yet a rather poor photograph clearly shows the extraordinary position into which the bones had been adjusted.

CASE IX.—L. S——, a girl of 13, had suffered for nine months with a large painful tumor of the left thigh. After amputation at the hip joint an X-ray photograph was taken of the tumor. The relation of the tumor to the femur, and the involvement of the bone were more clearly shown than was possible in any other way. The growth was an endothelioma. The patient made a good recovery.

CASE X.—A. F——, aged 19, a football-player, was injured in his left shoulder. There was great tenderness in the outer extremity of the left clavicle. It was impossible six hours after the injury to make out crepitus or deformity. A skiagram, taken after an exposure of some six or eight minutes, showed a solution of continuity at the seat of pain. On the strength of the fluoroscopic examination, the arm was put up in a Velpeau bandage. The young man evidently regarded the injury as trivial, for he never appeared again. I was informed, however, by the surgeon of the football squad, Dr. Balch, that a callus appeared at the point of tenderness a week or more after the injury.

CASE XI.—October 26th, 1896: Mr. G——, aged 51, four weeks ago began to have pain in the upper jaw. A tumor was conspicuous through which the X ray passed without interruption, except from a loose fragment, evidently a sequestrum. Operation showed an extensive necrosis of the upper jaw, with a loose piece of dead bone, as shown in the skiagram.

CASE XII.—October 27th, 1896: Mr. C——, aged 52, a syphilitic with extensive ulcerations over the tibia. By digital examination

there seemed to be an increase of bony substance. A skiagram, taken after an exposure of six minutes, showed the tibia perfectly smooth, without loss of contour or increase of bony growth.

CASE XIII.—October 27th, 1896: Miss B——, a nurse, aged 32, after a septic wound of the middle finger of the right hand, had not been able to straighten the finger for some weeks. The skiagram showed a bony ankylosis.

CASE XIV.—October 27th, 1896: Judge ——, aged 50, had received an injury to the left wrist, and feared that the bones had been injured. The fluoroscope showed nothing abnormal. After an exposure of four minutes to a plate, a very beautiful demonstration of the bones was obtained, which showed them to be perfectly intact.

CASE XV.—I. F. C——, aged 42, had an extensive swelling of the right knee, which was shown by the fluoroscope and by the skiagram to involve extensively both tibia and femur. The outline of the diseased parts could be clearly seen.

CASE XVI.—Mr. B——, aged 59, had had for ten years a marked hallux valgus. Examination with the fluoroscope showed the exact position of the bones. The distal end of the first metatarsal bone was removed and the great toe brought into the normal line. The man made a rapid recovery. A skiagram, taken a month or two after the operation, showed in an interesting manner the position of the cut surface of the metatarsal bone, with reference to the first phalanx.

CASE XVII.—Dr. ——, aged 44, in playing polo had received an injury to the first interphalangeal joint of the middle finger. There was considerable thickening, apparently of bone; yet both fluoroscope and skiagram showed that the bony portions were perfectly healthy. Evidently the case was one of traumatic arthritis without injury to the bone.

CASE XVIII.—A man of about 57 years received in a planing-machine a severe injury to the right elbow, which required the removal of a portion of the ulna near the elbow. There was marked impairment of function. Examination with the fluoroscope showed no abnormal position of the bones. The skiagram confirmed this. The ankylosis was evidently functional rather than organic, and the man has been put upon massage and passive motion.

CASE XIX.—Mr. D——, aged 38, had a Pott's fracture of the ankle, received from a fall in the street. There was marked eversion of the foot—much more than the position of the fragments would seem to explain. The skiagram showed a fracture of the fibula, with some injury to the internal malleolus, and a forward displacement of the tibia. No bony injury to the tibia could be

made out. The patient was sent to Dr. Goldthwait, who applied a steel support.

CASE XX.—A man, aged 32, in September, 1896, fell from his bicycle and received an injury to the left shoulder. He was treated in a hospital. I first saw him two months after the injury. Nothing abnormal could be detected on inspection. Careful digital examination revealed a slight deformity of the left clavicle. There had evidently been some kind of fracture, but the result was extremely good. The skiagram showed excessive displacement of the fragments. Such a skiagram as this would certainly indicate to the lay mind a deplorable lack of skill. The surgeon knows, of course, that such results cannot be prevented, especially in the clavicle.

CASE XXI.—Mr. X——, aged 34, shot himself through the thorax with a 32-calibre revolver, in November, 1893. The wound of entrance was two inches above and to the right of the left nipple. It was hard to see why the bullet had not penetrated the heart. Complete and lasting recovery followed. In September, 1896, in examining with the fluoroscope, I could see the bullet distinctly in the left and posterior part of the thorax under the ninth rib. After an exposure of thirty minutes a faint skiagram of the ribs, scapula, and bullet was produced. No operation was performed, as the missile was causing no trouble.

CASE XXII.—Mrs. B——, aged 66, has had for years severe rheumatic arthritis in the fingers of the right hand. An exposure of forty seconds gave an excellent idea of the osseous deposit.

Besides the foregoing cases, I have used the fluoroscope in many others—cases in which negative results were of great service to me in forming an opinion, such as demonstrations of the absence of fractures and dislocations, bony ankyloses and tumors. The usefulness of the apparatus is quite as conspicuous in cases of this kind as in those in which a foreign body or a bony deformity is present.

The medico-legal aspects of this subject, though at present uncertain, add strong arguments in favor of routine office skiagraphy. In fractures it is of the greatest importance for the physician's own protection that he should ascertain by the use of the fluoroscope the exact situation of the fragments, even if he has already an accurate idea of their position and shape, for if he does not recognize, even if he cannot correct, a faulty approximation, the deformity is pretty sure, sooner or later, to be detected by a complaining patient. It is only a question of time, I think, when every person who has had a fracture will try to have it photographed by the X ray. It will then appear, as we all know, that in many instances the bones

are not in perfect approximation. Indeed, fragments which have been brought together with the greatest care by the most skilled operators will often show, under X-ray photography, a reduction which, to the patient, appears unskilful. I recall one case in which one of the most eminent surgeons in this country reduced a fracture of both bones of the forearm. Though the position was absolutely perfect, as far as could be judged by any of the ordinary methods of investigation, an X-ray photograph showed that the fragments of the ulna were considerably displaced. The ultimate practical result was most excellent. The imperfect approximation would never have been suspected by ordinary methods of examination. Indeed, it is doubtful whether the fragments could have been better adjusted by the aid of the fluoroscope. Nevertheless, it seems to me, the use of the X ray is demanded in all cases, for some fractures are sure to be followed by an impairment of function. Unless, therefore, the surgeon can show that he has used every means at his command to understand and treat the fracture (and these remarks apply also to dislocations), his defence in case of legal complications—always liable to arise—must, of necessity, be weakened.

It is difficult to foresee all that may yet be done in aid of medical diagnosis in soft tissues. Little can be accomplished with the present fluoroscope.

The following is of interest in diseases of the chest:

THE ROENTGEN RAYS IN THE DIAGNOSIS OF PLEURISY AND PHTHISIS.*—Dr. Ch. Bouchard found that if a patient were placed between a Crookes tube and a fluorescent screen the side of the thorax occupied by an effusion presented a darker tint than the healthy one. If the effusion did not fill the whole cavity the apex was clearer, and the upper border of the darker part corresponded to the upper limit of dulness on percussion. The mediastinum was seen as a shadow (in the case of right pleural effusions) to the left of the sternum, the apex being above and the base continuous with the opacity due to the heart. He was first led to use the same method in phthisis by observing in one case of pleurisy that the apex remained dark after a clearer zone had appeared in the middle of the thorax. Percussion and auscultation showed that there was consolidation at this apex. In all phthisical patients subsequently examined, the shadows of the pulmonary lesions were seen. As a rule they corresponded to what one would have expected from the physical signs. In two cases clear patches on a dark ground marked the position of cavities already diagnosed by their physical signs. In two others,

* Lancet.

however, where cavities were diagnosed nothing abnormal was seen by the X rays. In one case where general symptoms pointed to commencing phthisis, but abnormal physical signs and bacilli in the sputum were both absent, the rays proved that one apex was more solid than the other, and a few days later bacilli and physical signs appeared.

As reports similar to Richardson's appeared in various medical journals of the year, the interest of many physicians in the narrative was followed by a desire to do the same thing themselves.

The chief obstacle in the way was thought to be the expense of particular apparatus required, and the difficulty of a satisfactory selection from among those offered by enterprising dealers. Large coils with an equipment of break wheel, motor, rheostat, and for use with the street current have an initial cost of from two hundred dollars to three hundred dollars complete. To this must be added the cost of operation and repairs; destruction of tubes, and the ever-present liability of a ruined coil by the heat of heavy currents, pushed for maximum effects. A repair may then cost nearly a new coil.

The great drawback to the favorable consideration of such an equipment by hospitals and practitioners (even those who can afford the expense) is the fact that it has no therapeutic utility and can only be used to excite Crookes tubes. The general introduction of coils during the first year of X-ray work grew out of the assumption that no other appliance would take their place, that they were essential to successful investigation in this field, and that, costly or not, they were Hobson's choice.

This belief was not discouraged by coil interests and was practically undisputed until high-efficiency Crookes tubes were developed for the form of therapeutic apparatus already possessed by hundreds of physicians and ready at their hand to serve them with little cost and with the utmost satisfaction.

This well-known electrical apparatus was the static machine, and the only condition required to enable the practitioner who had such an appliance to equal the best X-ray brilliancy ob-

tained by any one else, and surpass all ordinary coil effects, was the possession of Crookes tubes adapted to the static current and brief instruction in the ways of using them.

The evolution of the static tube took place gradually during the second half of 1896, largely through the persistent efforts of the author with various makers, but coils still practically monopolized the field, and knowledge of any other method spread slowly among the profession. On February 6th, 1897, the matter was for the first time definitely set before medical readers by the present writer in a published article* entitled "Crookes Tubes and Static Machines," written about a month before and quoted below, with the exception of the opening paragraph.

"The speaker had put a healthy young man, wearing all his clothes but his coat, between a tube of special construction and the fluoroscopic screen, and in twenty seconds he could clearly see not only the ribs, but the heart pulsating, and the latter was so distinct that it was possible to tell the ventricles from the auricles." Probably no physician who has read this paragraph has failed to recognize the possible value of such an aid to diagnosis, or to wish to procure an equally efficient tube for himself. There yet exists, however, great diversity in Crookes tubes. No standard size, shape, or degree of vacuum can be determined unless a standard current also has been decided upon. Each means of electrical excitation demands a different adaptation to itself of the size and shape of the tube, the size and relation of the electrodes, and the degree of vacuum. This has led to much misunderstanding, to many conflicting and unfounded statements by different writers, and to many disappointments on the part of buyers of tubes, suited, perhaps, to other methods of excitation, but ineffective in their own hands. In the paper on Roentgen's discovery which I read before the Kings County Medical Society on April 21st, 1896, I then said: "A powerful static machine with Leyden jars and transformer coils will do fairly good work, but far from the best."

This opinion was shared by all the leading workers in the field at that time. It was based upon the tubes then made, but it is no longer true. Until June my own observation and experience continued to confirm my belief in the superiority of the coil apparatus I described in April. During the past four months, however, I have

* Medical Record, February 6th, 1897.

made a large number of experiments to determine the actual facts in regard to tubes and exciting apparatus for physicians' use, so that the physician who has a choice between therapeutic and non-therapeutic electrical apparatus may employ the one that will serve him best and profitably.

There is a general confusion of ideas among makers as to what constitutes a "high-efficiency tube." Some are satisfied with a display of the bones of the hand. Very few makers or expert operators really know the full capabilities of a superb tube, for few have seen them developed. Common tubes of ordinary vacuum are now plentiful. They will glow with coils giving from two to six-inch sparks, and gratify the wayfaring man, who is amazed to see his own bones; or they will produce negatives of even the trunk of the body in the course of time. These ordinary effects are of but insignificant value in diagnosis. Tubes suited to larger coils, giving ten to twelve-inch sparks, may also easily be obtained. Double-focus tubes and alternating currents are also available, and are often regarded as exceptionally efficient. When these tubes are purchased by physicians who have static machines and have read that they can be used to produce X-ray effects, the result is almost invariably disappointing.

To explain why this is so, and to enable medical users of Crookes tubes to employ their own apparatus successfully, are the objects of this paper.

When the bulb of a tube is of a proper convexity, it will throw rays upon a screen held at many feet—ten or even twenty—from the tube itself. Such a rounded convexity is required to make fluoroscopic examinations through thick bodies, for if the bulb is acutely oval the rays will quickly converge and the maximum of efficiency fades at once within a very few inches of the tube. If the internal electrodes are too far apart or too near together, they impair the effect. The space between them best suited to the large Holtz machine is three inches, with a margin of one-half inch either way, according to the size of the tube. Very small or large tubes are unsuited to static machines, as a rule, although the construction and vacuum may be so well adapted to this current as to make exceptions of special tubes. Medium sizes have been the best that I have seen. When the external terminals of a tube are connected directly to the prime conductors of a Holtz machine, we have an immediate and infallible test of the vacuum. What the correct vacuum should be cannot be stated in terms of fractions of an atmosphere, but the demonstration of its degree is as absolute as mathematics. If it is a very low vacuum, the electrical discharge will pass in a bluish stream between the electrodes, and no luminosity

will glow in the tube. If it is a little higher vacuum, the visible blue stream will disappear, and in proportion as the vacuum rises the green glow will increase in brightness. At the same time the spark stream between the prime conductors is also indicating the vacuum to be very low, or some degree between very low and very high.

A current will pass through conductors in the direction of least resistance. If the vacuum is low its resistance may be so small that it may equal only a small fraction of an inch of air gap. A vacuum so high that a six-inch spark coil will send nothing through it, may demonstrate no more than a two-inch spark stream between static poles. A suitably high vacuum should force back by its resistance at least one and one-half to two inches of spark stream. The green glow in the tube will then be exceedingly bright, and X rays can be developed of very high efficiency. No tube that does not furnish this demonstration is adapted to large static machines, and if physicians will ascertain the facts before buying tubes they can avoid both disappointment and expense.

The outer terminals of a proper static tube must be about ten inches apart, and attachment to machine should be made with insulated wire of about No. 18 in size, as the fine wires so often employed sway too readily and leak off the current when the attraction of opposite polarities brings them near together.

I have kept a written history of the behavior of thirty tubes, tested in recent months, in my office. A tube of lower vacuum than it should possess for convective-discharge excitation will produce efficient X rays when the oscillating static current is used with small Leyden jars. The maximum of steadiness and radiance can be found by short-circuiting the poles and then gradually drawing them several inches apart until the best effect is developed. The plates of the machine should revolve as rapidly as is consistent with safety. This method is open to objections. It is noisy and the oscillations try the eyes. It sets up some heat in the tube, but very little as compared with the street current. The convective method is preferable. When the vacuum is just right the terminals may be attached directly to the prime conductors of the static machine, without employing any jars, coil, or other device. Revolve the plates rapidly, and on drawing the poles apart the tube will instantly light up with the brilliant green phosphorescence so familiar now to all.

If the electrodes are in proper relation all the current will be focussed upon the anode, and the bulb will appear in twin diagonal hemispheres—one in eclipse and the other luminous as the sheen of a strong light. If, now, the hand is examined through the fluoro-

scope. the bones that were merely a black shadow with a tube of low efficiency will be nearly as white and transparent as the soft parts. The beautiful mechanism of the wrist joint will appear in clear detail. A group of metallic objects on the back of a pine board will show through books of twenty-five hundred pages, or a heavy brass tray, such as I use for a foot-plate with my static machine. When a tube does this, I know it is a good tube. By further art of management, such as all tubes require, efficiency can be still further developed, and demonstrate the ribs, the spinal vertebræ, the movements of the heart, and all other effects so far attained by any operator with any means.

The tube does not overheat, and there is no apparent tax upon it or limit to the time it may be run at full power. It does not break down under strain, and it cannot be overloaded. The convective current makes no noise. The glow of the tube is as steadfast and unwavering as moonlight in an unclouded sky.

This economy in the durability of tubes is a factor of great importance beyond the first cost of the tube, for a tube that has proven its high worth and exceptional capacity is priceless. Money alone will not replace it if it is injured or broken. Moreover, none of the alleged injurious effects of X rays, reported hastily and with more or less sensation, are caused by the static current.

It seems wellnigh impossible that alopecia and dermatitis should be attributed to X rays by practical medical observers; but as they have been so attributed and no one has yet (Dec. 15, 1896), pointed out the error of this view, the simple fact may here be stated that these electrical or heat effects, which resemble sunburn, result from the action of heavy currents operating large coils and are not due to X rays. Roentgen's classical report contained the statement, "The rays have no calorific effects"; and I am not aware that any one has yet shown Roentgen to be mistaken, and the static current is not electrolytic.

The advantages of safety, facility, life of tube, comfort in operating, absence of heat effects, and stability of the radiance are among those afforded the physician by the static machine. The questions of cost and availability are also to be considered. When no tube was made that would operate well with the static machine, the coil was obligatory, but the large coil outfit cannot be used by the physician in medical practice and is a useless luxury when not producing X rays. The superior value of an office or hospital equipment, costing no more than an approximately effective coil outfit and capable of a wide range of therapeutic uses, is self-evident. Such an equipment is to be found in the improved Holtz machines now made. This type of electrical apparatus can be operated by

the surgeon, or general practitioner, or specialist far more readily than can galvanic or faradic batteries in their therapeutic work. Instruction in its management can as readily be procured as instruction in the use of any medical or surgical apparatus. But its double advantage of value to the physician in two fields instead of the single utility possessed by the Ruhmkorff or Tesla coil would not suffice to displace the coil if the latter was much the most effective in X-ray work. The time is nearly at hand when leading hospitals and physicians throughout the country will be deemed behind the age if they are not prepared to employ this aid to diagnosis. It is therefore important to point out the satisfactory fact that electro-therapeutics and the maximum of X-ray efficiency are obtainable with the same apparatus—to wit, the static machine. I am aware that nearly all the weight of authoritative utterance up to this date is against this conclusion. Nevertheless, I have never failed to demonstrate its accuracy since I have been able to procure tubes made partly after my own suggestions and adapted to the static apparatus. The whole matter lies in adapting the tube to the apparatus, and not the apparatus to the tube. When this is successfully done the demonstration of superior efficiency is complete.

I recently showed certain effects to an expert maker of Crookes tubes, and asked him what a coil would cost which would produce equal effects. His reply was emphatic that "no such coil could be bought at any price, not even for a thousand dollars." On another occasion another leading maker stood in open-eyed astonishment before a tube in my office which was excited by my eight-plate, thirty-inch Holtz machine. The plates were run at high speed by an electric motor, and the screen glowed as if striving to burst into incandescent light. He had seen the best effects produced in the laboratories of distinguished electricians, and he was an accurate judge of progressive advances in this field. He not only came to my office predisposed in favor of coils but had been informed by world-renowned authorities that the "static machine would break tubes and was inferior to the poorest coil." Without a word of argument on my part he gazed at the, to him, marvellous radiance so easily and instantly produced in his own tube, which his own coil would not excite at all, and made the following remark in a deliberately impressive manner: "I now see that the best way to excite a Crookes tube is with the static machine. No coil will equal it."

It is my belief that with a static tube I can demonstrate the truth of this conclusion to every competent observer. I have never broken a single tube in any of my experimental work with this ap-

paratus, although I have at various times employed in tests between forty and fifty tubes of different makes and construction. I have never discovered any of the injurious heat effects reported by those using street currents of large amperage, and my tubes will operate for hours at about blood temperature. Some experimenters early abandoned the static machine in X-ray work and turned again to the coil; others have seen demonstrations of all methods by some of the best experts in this country and have relegated the static current to the second or third place. There are several hundred physicians to-day who would eagerly employ Roentgen's wonderful discovery by the aid of the apparatus they already possess, if they were aware that it could be done. To a hospital the advantage of utilizing a therapeutic machine already among the essentials of its equipments is manifest, for few hospitals can afford additional and costly luxuries for diagnosis alone. Moreover, any coil or tube which will do less than show the heart beat, or fail to produce a good negative of the trunk of the body of an adult with an exposure of five minutes, does not possess the high efficiency a medical man requires.

But three things are needed to place this degree of efficiency in the hands of all who desire:

1. A Holtz machine of the therapeutic type and size, operated by any means that will turn the plates rapidly.*

2. A Crookes tube specially adapted to this form of high potential current.

3. A practical knowledge of technique.

I am sure that this will be welcome information to many phy-

* Among the questions frequently asked me by physicians is one relating to the revolution of the static plates in X-ray work. Some obtain the impression that a motor is required and others ask how fast the plates should turn.

Every static machine reaches its maximum of current output only when it is run as fast as it can. As the machine has been made in the past it is very tiresome to keep up this speed by hand power, and X-ray work all requires a maximum speed and a maximum current. This, however, need not disappoint those who reside in localities where neither electricity nor water power is available for the operation of a motor.

Neither is it necessary to go to the expense of a small engine, for the simplest way out of the difficulty for those who use a household servant or an office boy to turn their static machine is to adopt the principle of the bicycle gear. This would involve but little expense and probably in the early future all manufacturers will deliver their machines without a belt, as at present, but with a fine bicycle chain, a front sprocket wheel of perhaps fifty teeth, and an axle sprocket of about eight or ten teeth, so that an ordinary rate of revolution which can be comfortably maintained by hand will drive the wheels at the rate of an electric motor. I would suggest this as advisable.

sicians who hesitate at the extra expense of a good coil. Of the accuracy of the statements here made I have had the most convincing proof during a sufficient period to remove the uncertainties of hasty judgment. I have demonstrated the facts both to physicians attending my clinic and to manufacturers who have previously been sceptical. I am prepared to maintain: 1st. That no methods now known, however costly, will surpass the efficiency of the Holtz machine with tubes suited to it. 2d. That the Holtz machine and tubes adapted to its maximum discharge will readily and economically equal, or surpass, the best X-ray effects producible by any, or all other means, of electrical excitation, with any design of tubes that can now be obtained.

The immediate effect of this article was a large number of letters of inquiry from physicians all over the United States, expressing the utmost interest in the subject and desiring a knowledge of working methods which will be presently described.

As it is already almost universally conceded that the physician or surgeon who does not either possess, or have access to, means of making X-ray examinations will soon be regarded as somewhat behind the times, the question of current sources for exciting Crookes tubes is of the first practical importance. Those who dread the care of batteries or complicated apparatus may be surprised to learn that the static machine is the only apparatus which is absolutely independent, simple, and self-sufficient.

There are to-day three forms of mechanism from which to choose, the Ruhmkorff coil, the high-frequency coil, and the static machine. The first coil requires for its operation a direct street current, or storage batteries which must be charged from the street current, for primary cells are hardly to be considered in connection with fine work and an expensive coil. Unless therefore the physician has at command the above electric source of supply he cannot use a large Ruhmkorff coil on a practical scale.

The high-frequency apparatus is actuated by an alternating current only. Unless this current is available, or a transformer

is employed, the second form of apparatus for generating X rays is useless. In considering the above the physician will also find that they present numerous complications and are the reverse of simple. The cost of operating them cannot be computed in advance, for in different cases it will vary from a small sum per week to an amount so large that it becomes quite formidable.

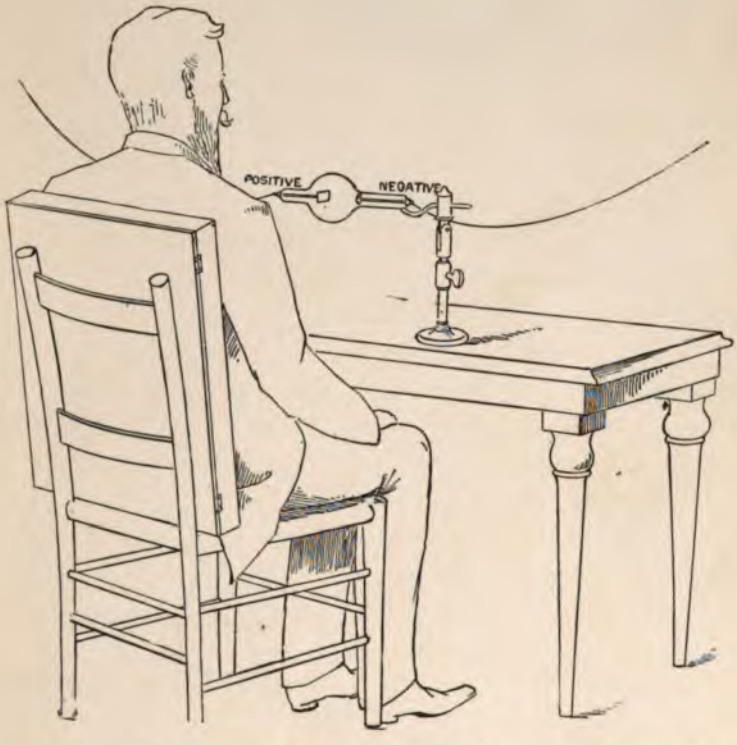
The fortunate possessor of the static machine has at hand the most simple and convenient apparatus for producing the most brilliant X rays. As it generates its own electricity it is independent of any electric-light circuit. It can therefore be operated in any location either in the city or the wilderness, for wherever it stands it is complete in itself. So far as relates to mechanism, accessories for Crookes tube work, and methods of operating, it combines simplicity, safety, and convenience. Its merits can only be appreciated by familiarity with its operation.

A moment's reference in passing will illustrate the efficiency of this machine in its simplest form of use.

Among my tube histories is an entry dated September 4th, 1896:

Tube No. 9, style W, size medium, maker ——; received to-day. Glowed at once. Improved rapidly. In half an hour we were seeing key and nails in a test-board, not only through a sixteen-hundred-page book but through my brass foot-tray; and all bones of arms, legs, spine, and ribs; shows shoulder joints very plainly, glows screen through trunk of body and shows ribs, vertebræ, and heart action. Medullary canals show in all the bones. Gives good effects at distance with wide radius of action.

On September 18th, this same tube was selected for a test experiment of an exposure limited to five minutes through the trunk of the body. The resulting negative (developed by myself but printed by a photographer) is corroborative evidence of the fact, then often stated to me by visiting physicians, that the X-ray demonstrations made in my office with my Holtz machine were not equalled in brilliancy by any they had ever seen elsewhere.



The above diagram shows the author's method of seating a patient for an X-ray photograph of the chest. The large plate-holder is placed behind the back and held in position as the body leans against it. The tube stands on a table in front of the subject. The plate-holder (14 x 17) can be raised or lowered, as desired.

This easily obtained picture, 14x17, shows small pins, hair-pins, and a pair of small scissors secured upon the back of a fully clothed adult woman, along the entire length of the spine. It also shows the whole osseous structure in complete detail, the heart shadow, exquisite detail of ribs, shoulder joint, vertebræ, corset steels, both anterior and posterior, and lighter shadows of the clothing outside the shadows of the flesh.

The tube was thirteen inches in front of the chest. Adding to this about eight inches thickness of the trunk, and one and one-half inches from the tube wall to the anode reflector, we have a total radius of action between photographic plate and anode of twenty-three inches at the upper border to twenty-eight inches at the lower border of the plate. Exposure time exactly five minutes.

I have still the same tube in prime working order, it having required a fresh exhaustion once. The plate was taken with simple connections to direct prime conductors with no jars or spark-gap devices.

Let us now step aside from the testimony of my own experience to substantiate statements regarding the superiority of the static apparatus for "the ready and profuse generation of the X rays" by an extract from a paper read before the electrical section of the Franklin Institute, Philadelphia, December 1st, 1896, by two coil manufacturers and competent authorities. Premising their exhaustive paper by the mistaken statement that "the coil is the only apparatus known which will readily and profusely produce X rays," and by the remark that they had been engaged for a number of months past in developing apparatus and methods for practical work, with a special reference to the needs of the physician and surgeon, they discuss minutely every subhead of the subject and finally conclude as follows:

Two arrangements of the induction coil are advocated. The one is known as the Tesla or "high-frequency" coil, and the other is the direct and old-fashioned use of the simple induction coil, in which

the secondary electro-motive force is delivered direct to the terminals of the tube.

Having carefully examined the results, apparatus, and methods of others all over the country, devotees, some of the "high-efficiency" coil, some of the induction coil, and having made many and careful experiments with both forms of apparatus ourselves, we favor the induction coil. Our reasons for this preference are briefly stated:

A. Simplicity. One coil instead of two.

B. Ease of manipulation. There being more than double the number of factors to attend to in the Tesla coil than in the induction coil.

C. Cleanliness. The "high-frequency" coil requires an oil-bath, which must be renewed from time to time to avoid gumming. It is difficult also to find an oil which will not eventually act upon the insulation of the wire by virtue of the acid or other impurities which the former may contain.

D. Sharp definition. The "high-frequency" coil produces an alternating discharge—thus from the double-focus tube, giving us two sources of X radiation, and consequent blurring of the image. If a single-focus tube is to be used, the discharge in one direction is either lost or tears off particles of the platinum reflector, thus blackening the tube and soon destroying its effectiveness.

E. Noiselessness. This from the surgeon's and physician's standpoint is perhaps the most important consideration. With tube in action the induction coil is practically noiseless, save for the low hum of the motor or vibrator. Improperly designed vibrators often rattle and rasp in a very irritating manner. In the "high-frequency" coil, however, the disruptive discharge over the air gap is the vital cause of the action. It is much more violent than a discharge of corresponding length from the induction coil, being of a rattling, cracking character. That such a noise cannot but have a most unpleasant effect upon the patient who comes into the operating-room in a condition of more or less nervous collapse is obvious.

F. Strain on tube. It has been argued by the advocates of the "high efficiency" coil that it is much less hard upon the tubes. Our own observation has been just the reverse of this, and has satisfied us that the wear and tear is very much less with the induction coil.

Sticking of the vibrator must be guarded against; it is often fatal to the tube. This is because of the much larger current to the primary when such sticking occurs. The tube, therefore, receives much more energy than it should, and may break down.

G. Results. Although we have diligently examined, we have yet to see the results obtained by any form of apparatus superior to

those made in Philadelphia, either as regards detail, penetration, or quickness of exposure. Indeed we may say that we have never seen results with the Tesla coil that are equal in any of the above respects to the results just referred to.

The life of tubes in general is limited: (*a*) By time required for the vacuum to become too great, hence requiring re-exhaustion. (*b*) By ability to stand the electrical strains. Probably six or eight hours' continuous working, or the equivalent, suffice to incapacitate the average tube.

We have obtained well-defined pictures showing complete detail of the osseous structure with distances from dry plate to reflector, as below:

Hand and wrist, five to ten seconds at five inches.

Forearm, ten to fifteen minutes at five inches.

Arm above elbow, one-half to one minute at seven inches.

Shoulder, ten to fifteen minutes at ten inches.

Thorax, fifteen to thirty minutes at ten inches.

Hip joint, thirty to forty-five minutes at twelve to fifteen inches.

Stone in kidneys, thirty to forty-five minutes at twelve to fifteen inches.

Glass, iron, lead, etc., in any part of trunk, thirty minutes on an average at twelve to fifteen inches.

We have very carefully investigated every claim to quicker exposures than these, often by a personal visit, sometimes by correspondence with personal friends whose reliability was undoubted. We have been unable to learn of any results equally good, having been obtained in shorter times by any one at any place,* with any form of apparatus, and we do not believe any such have been obtained.

* These times and distances are for coils. With the author's large Holtz machine and special tubes, giving greater penetration and radius of action, the above times may be greatly reduced. With one of my best tubes five minutes' exposure would equal any of the above coil pictures with six times the exposure. The advantages of short exposures to patients who find it difficult to keep still for half an hour is obvious.

I have also seen a $300 coil capable of doing much finer and quicker work than these writers admit can be done. The same tube was used, however, as that which I employ with the Holtz machine. This was in the Massachusetts General Hospital in Boston.

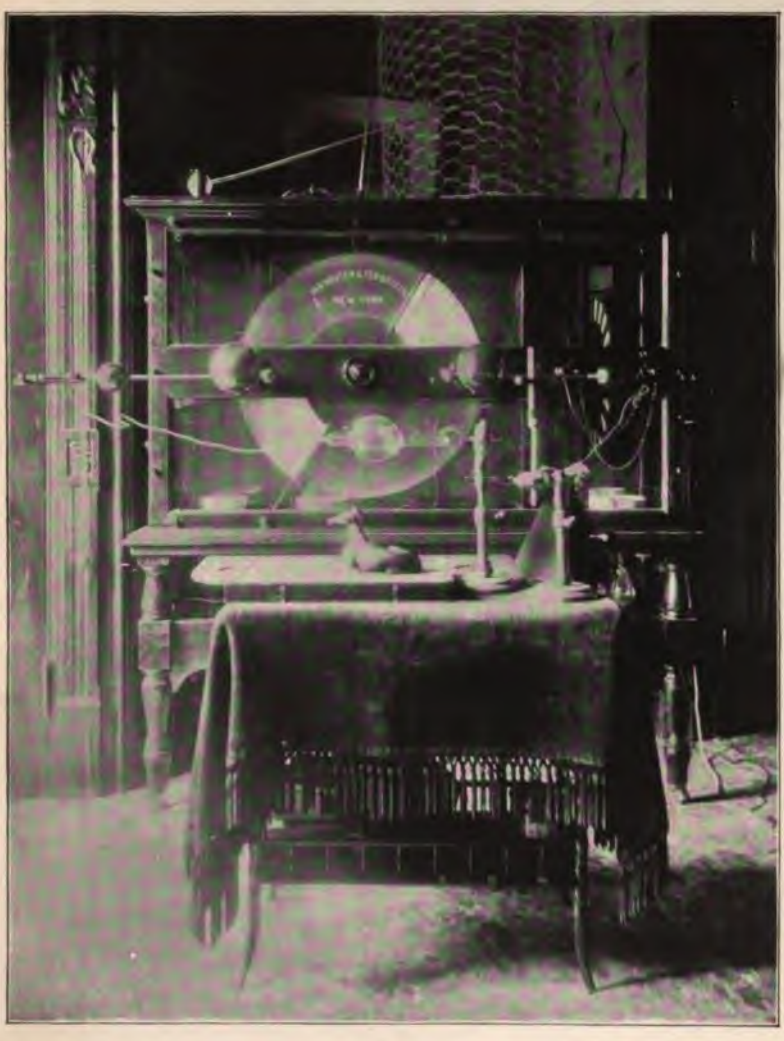
CHAPTER VIII.

X-RAY APPARATUS AND CROOKES TUBES.

The Holtz apparatus preferable for surgical and medical X-ray uses. It combines advantages of high efficiency. A complete outfit for X-ray work. Technique of static methods in the general information required by the physician. The effective type of Crookes tube for static machine work. Method of adjusting tube for examination. How to test the vacuum of a static tube. How to raise a moderately low-resistance vacuum. Variability of the vacuum of Crookes tubes. The author's explanation of the cause. How to secure the greatest degree of stability. Crookes tube manufacturing no longer guesswork. The problem of adapting tubes to the Holtz apparatus definitely solved. A standard measurement of the vacuum. Example of a high vacuum tube. To reduce a high-resistance vacuum. When a tube needs to be re-exhausted.

No more judicious setting forth of facts relating to coil drawbacks has yet been published than that contained in the preceding chapter. But if we accept the verdict of advocates of the coil and find that it declares an inferiority with the static machine which cannot be computed in units of facility, economy, satisfaction, noiselessness, readiness of action, safety of tubes, eye and ear strain of the operator and subject, number of factors requiring attention and care, liability of expensive damage; when we find, moreover, that the cost of the Holtz machine and a prime coil is about the same, that one cannot relieve a single patient's suffering in clinical work and that the other is among the most efficient and valuable appliances in an electro-therapeutist's outfit, whether in sanitarium, hospital, or private practice, argument for the coil falls to the ground and must cease to command the therapeutist's attention.

I may also state that an expert manufacturer and operator of Crookes tubes and other varieties of apparatus, who operates a six-inch spark coil in his own laboratory, informed me on Feb-



Author's X-Ray Apparatus. Showing position of Crookes tube over object on photographic plate-holder.

ruary 14th, 1897, that he had recently spent an entire half-day with the authors of the paper from which I have quoted and witnessed the best X-ray effects they could produce; that he had devoted a week to investigating every prominent type of equipment in the large Eastern cities, and that none had equalled the effects demonstrated to him by my static machine in my office. This is the usual remark of competent observers who have been familiar with other apparatus and see for the first time a powerful Holtz machine in splendid action. Convinced, therefore, beyond present controversy that the most desirable apparatus for X-ray examination in medical work is the improved static machine, we may proceed to methods and the accessory parts required.

The Author's Apparatus Complete.—An eight-plate, thirty-inch Holtz machine, Van Houten & Ten Broeck, with interior Wimshurst charger. One-sixth horse-power motor run by street current. A twenty-five button 125 ohm, Carpenter enamel rheostat for speed regulation.

Several Crookes tubes especially developed for static use by the author's suggestions to the makers.

Two combination tube-holders. Fluoroscope, 6x8.

Three sizes of Leyden jars.

A pair of current interrupters made for me by the J. Kidder Manufacturing Co., of New York City.

One 14x17 plate-holder (not a necessity).

One 14x17 special photographic tungstate of calcium screen (not a necessity).

Photographic plates of sizes from 4x5 to 14x17.

A ruby lamp, pans, and chemicals.

For developing plates I simply use a butler's pantry with the door shut, for a dark room.

As screen, tubes, plates, and other accessories are made of various sizes and cost, the proper place to obtain current information on commercial details is the dealer's list, and accordingly such details are omitted here.

High-efficiency apparatus and tubes are not always the only essentials to success. Results are not automatic achievements. So much depends upon the operator that comparatively trivial differences in procedure make the differences between brilliant and commonplace results, or between fair success and total failure.

General Information Required by the Physician.—1. A knowledge of the operation of the Holtz machine. 2. A knowledge of all the varieties of tube manipulation. 3. The ability to detect at a glance all faults of working and correct them. 4. A knowledge of what actually represents the maximum capacity of the given tube. 5. How to tell a poor tube from a good one by an instant's examination, and a knowledge of both the limitations and highest possibilities of Roentgen effects.

Experience discloses the fact that very few at this date know what high-grade X-ray work is, yet every physician should fully inform himself.

Unless the operator is informed on these elementary points he gropes in the dark without aim or object.

Tube Position.—Secure the tube by its handle in the holder so that it will stand horizontally upon a table in front of the apparatus, with the end containing the round disc electrode nearest the negative pole. Take two pieces of insulated copper wire of about No. 18 size and about three feet long. Expose both ends of each wire, bend one into a small hook, and hook it to the terminal of the tube; twist the opposite end of the wire around the metallic part of the sliding pole piece farthest from the centre, so that the positive and negative poles of the machine will be attached to the positive and negative ends of the tube, with the wires diverging far apart. The cathode end of the tube contains the round disc, and this must always connect with the negative pole of the machine for X-ray effects. Test current for polarity before connecting the tube.

Turn the tube so that the platinum reflector presents toward

the eye when the operator stands in front of it. The poles may either be drawn apart or short-circuited, and the jars may or may not be attached to the prime conductors. These last details are of minor importance, but as a rule it is well to separate the poles four or six inches while the machine is starting into action, and to employ the largest jars in open circuit. The jars serve to reinforce the convective discharge and must not have their outer coatings connected.

How to Test a Static-Tube Vacuum.—With the tube now in place, and connected simply to the prime conductors of the static machine, darken the room and start the plates into action. When they attain a rapid speed (but safely below racing) draw the poles apart and note how long a spark stream follows their separation. One of three things will appear from this test of the tube: 1. The spark stream may attain a length of from one to two inches, and as the poles are drawn beyond this distance the spark will cease and the tube will suddenly glow with the proper green luminosity and the fluoroscope will demonstrate good X rays.

2. The spark stream may be less than one inch, or be any length, down to the mere thickness of a sheet of paper, between the poles, and in proportion as the stream is short the green glow will become dull, bluish, or absent entirely; and when only very short sparks occur the electrical discharge will form a visible bluish streak directly between the two electrodes. This denotes a low vacuum and if the discharge is pink the tube is so low as to require re-exhaustion.

3. The poles may be drawn beyond the longest distance that a spark will pass between them, and the current may back up and leak from the conducting wires without going through the tube, which will remain dark or occasionally a flicker may pass through it. This proves a high vacuum.

This is the first test to give every new static tube before using, to determine its exact value and what next step to take to increase its efficiency.

If the immediate result is seen to be number one, the tube has a satisfactory vacuum and is ready for work.

If the result is number two, the vacuum is too low. If the electrical discharge is visible as a bluish or pink stream between the internal electrodes the tube should be rejected, or sent to the makers to be again exhausted, if it suddenly loses its vacuum to this degree. A tube will sometimes do so without any apparent explanation.

If, however, the vacuum is high enough to back up at least half-inch sparks, and display even a dull green with sufficient X rays to show the bones of the hand in even dark detail, the tube may be readily coaxed up to fair efficiency.

If the result is number three the vacuum is too high and must be reduced. If this can be done to a proper point (and it usually can) the tube will be among the very best obtainable.

How to Raise a Moderately Low-Resistance Vacuum.—The first and simplest step—often effective—consists in turning the tube around so that the anode and cathode are reversed. Hook on the wires from the machine and again test it with a correct polarity. If this results in good rays the tube is ready for use.

If it has not proved successful remove the wires from the prime conductors, attach them to the connections for Leyden-jar currents, and place the smallest jars in position. Short-circuit the poles. The jar from the positive prime conductor is negative and the direct polarity is reversed. Remember this. Connecting the tube cathode terminal to the positive Leyden jar, start the machine into rapid action and draw the poles apart until the spark stream splits and the glow in the tube begins to oscillate. Continue this discharge through the tube for about five minutes. During this treatment the poles will vary with different tubes from four to eight inches apart according to the condition of the machine and state of vacuum.

Next stop the machine and resume correct polarity, short-circuit the sliding rods, start the current, and when the plates

revolve as rapidly as safety to the apparatus permits draw the poles apart until the glow wavers. Use the hand over the fluoroscope as a familiar test and adjust the distance between the poles until the bones appear brightest and the image steady. If the bones are somewhat dark the vacuum is still lower than it should be. Keep the spark stream in action for five or ten minutes and if the tube is worth coaxing at all it should now produce X rays of fair efficiency.* If these are from fifty to seventy per cent of the best light obtainable from a high-power tube with a correct vacuum it is now as nearly ready for work as it can be got without a fresh exhaustion.

Variability of the Vacuum of Crookes Tubes.—Physicians just beginning their experience with Crookes tubes must not interpret anything stated in writings upon the subject to mean that even the best tube possesses a reliable, steady, and always available degree of vacuum. Crookes tubes are as changeable, within certain limits, as a thermometer, and will never become constant in working qualities, but the variability of the vacuum can be greatly reduced by proper elementary exhaustion. I do not, however, agree with the theory that the alteration which sometimes makes the vacuum appear very low, and sometimes very high in the same tube, and without apparent reason, is an actual change in the rarefaction of the gases in the bulb.

It seems to me impossible to maintain any such theory, for otherwise it could be demonstrated that a tube would exhaust itself without a pump. Close observation of many tubes leads me to believe that what takes place is some rearrangement of

* The most difficult part of X-ray work to comprehend from written instructions is the electrical manipulation of tubes. While the processes are simple to understand when once seen, and involve no real difficulties when explained during an object-lesson, yet it is something like describing shades of color by words to attempt to write down the art and technique of mastering a refractory Crookes tube.

The value of different degrees of radiance can be demonstrated much better than described, and a couple of hours' instruction will enable the physician to accomplish results at once with a success which is otherwise attained only after considerable experimental delay and disappointing outlay of money.

the atoms or ions in relation with the electrodes. A definite polar action is constantly going on within the tube during the passage of the electrical current. It is not necessary to consider the actual occurrence of chemical electrolysis by static currents to admit that atoms of some nature within the tube may be attracted to the negative pole, and atoms of an opposing nature to the positive. To those familiar with what occurs at galvanic electrodes of bare metal in different solutions, the merest mention of the probability is sufficient.

When action occurs too long in one direction the electrode within the tube evidently becomes in some degree "polarized," so that part of the efficiency of electrical excitation is lost. When we reverse the tube I do not admit that we actually raise the so-called low vacuum to a high vacuum, but I believe that the bombardment of an opposite polarity releases the interfering ions, shakes loose the particles around the electrodes, permits a normal rearrangement of them, and to express it in simple phrase, "clears the atmosphere."

After such a preparation we resume the test of the tube with a working current and find that it has greatly improved. Rest evidently tends to do the same thing, and in many cases there is a gradual re-establishment of the deranged atomic relations during the lapse of time, just as a cutting edge will come again to a favorite razor which the owner temporarily lays aside after fruitless efforts with the strop.

An example from my experience will illustrate this. On October 4th, 1896, a tube which had been one of the best seen by the writer was in action taking a picture of a hip-joint. It was working brilliantly. After two minutes' exposure the glass suddenly smoked over, something as a lamp chimney would smoke if the blaze flared too high, and luminosity and X rays died out completely, and the vacuum apparently went down to an exceedingly low point, without, however, puncturing the tube. It was set aside, and in a week sent to the manufacturer to be repaired. He returned it by my messenger with the re-

port that it could not be fixed, and did nothing to it. This was the first and only tube I have ever seen smoked with the static current. The Leyden-jar current did it.

About the first of November I happened to take up the tube again and found that it now worked as well as tubes which are ordinarily considered satisfactory. If the vacuum had really become low it must now in some way have become high during the lapse of a little over two weeks' time. It cannot of course be admitted for one moment that self-exhaustion against atmospheric pressure is a possibility, but such changes are reasonably accounted for by the idea of the accumulation and displacement of ions at the electrodes.

Glassblowers are accustomed to say that air bubbles secrete themselves in and about the wires and discs while the tube is being exhausted, and that these bubbles go in and out like hedgehogs from their holes, and raise or lower the vacuum in this way. Such a theory is too crude an explanation to be considered.

To secure the greatest practical degree of steadiness and stability it is essential that the proper vacuum should be entirely true pump exhaustion. The common habit of makers to hurry out a lot of tubes with the pump, and then manipulate higher degrees of vacuum (?) by electrical discharges through the tube from coil currents, is perhaps the cause of by far the greatest part of what is supposed to be inconstancy in the "vacuum." A true high vacuum has not been obtained, but a partial vacuum has been manipulated to present the fictitious appearance of proper efficiency.

It is this fictitious portion of the state within the bulb which is so subject to change and the cause of so much annoyance. Owing to the nature of the static discharge it does not produce such variable effects upon the atomic relations within the tube as the coil current, and it is necessary that static tubes should be exhausted to a proper degree of vacuum by the mercury pump alone.

Having closely observed every step in the evolution of a Crookes tube from a simple glass cylinder to the sealing of the handle at the close of exhaustion, and thereafter given the same tubes a series of experimental tests, I am convinced that a careful and reliable manufacturer who avoids electrical manipulation and prepares the vacuum entirely with the pump, will give the most satisfaction to his customers.

The glassblower can make any desired shape of tube at will, the exhaust pump can be stopped at any degree of vacuum, and if a standard is known, a thousand tubes can be made in almost exact duplicate. The mechanical process is free from difficulties. Why then are fine static tubes so hard to get? The whole explanation is found in the fact that makers have a coil in their shop for test purposes, and not only depend on guesswork in exhausting the vacuum for a Holtz machine, but when a static machine is supplied them for trial tests they are unable to use it, for they know nothing of its operation. When any maker advances to the point of employing a properly operated Holtz machine to standardize his tubes for static use, the whole difficulty will be solved. There is in reality no difficulty to solve, for I have definitely determined the shape of the best tube and the gauge of the best vacuum for static work.

Every test made by me during the past six months corroborates the view which my first demonstration suggested, that the proper vacuum for static tubes adapted to average large Holtz machines is indicated by an internal resistance which will force back a spark stream of between one and one-half and two inches.

When the vacuum of such a tube begins to be available for good X-ray work, its resistance equals a three-quarter-inch spark gap. Efficiency rapidly rises up to two inches, but somewhere about this point, or half an inch beyond it, the internal resistance becomes so great that the current no longer readily passes through the tube.

As it is the general tendency of tubes to increase their internal resistance during work, it is obviously necessary to leave

the vacuum at a point which will allow a reasonable margin for changes up and down during the life of the tube, without hovering so near either extremity of high or low vacuum that slight variations will destroy usefulness. I have therefore suggested for the definite standard of exhaustion the resistance test of a spark stream equal to one and one-half inches.

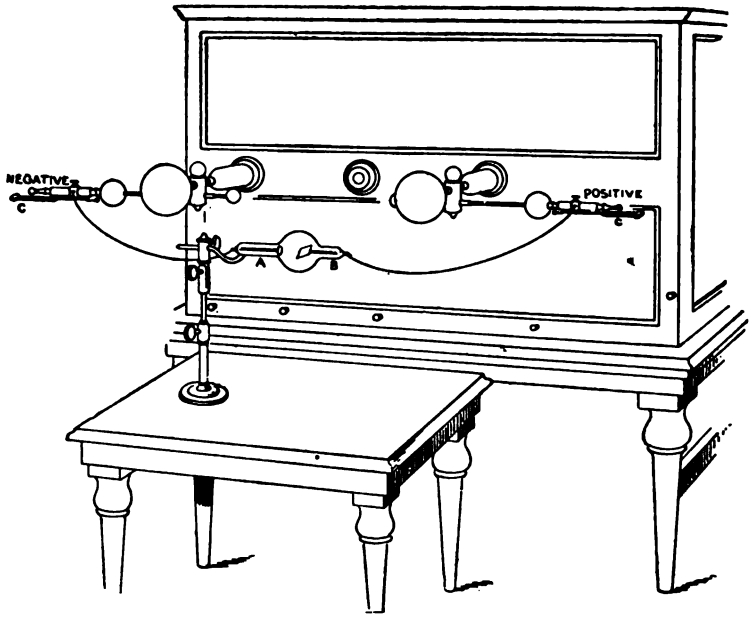
Allowing some leeway above and below this (for mathematical precision cannot be obtained in such matters), workmen inform me that having ascertained from me the proper standard, they can produce such tubes in any desired quantity and practically guarantee them to do satisfactory work in properly skilled hands. They can now be obtained from dealers.

I have said that when the internal resistance of a Crookes tube equalled about two and one-half inches spark gap between the prime conductors of the Holtz machine, the current would not readily go through it.

This is true with average machines under ordinary conditions. I will state an exception. A tube, which is No. 36 in my records, was exhausted under my personal supervision by the mercury pump to a point which had been arranged as a test. Upon taking it immediately from the shop to a static machine it forced back a spark gap of two and one-half inches and would not fluoresce. Owing to the fact that the static machine was not in perfect working order, and as certain necessary facilities were wanting, it proved to be impossible to glow the tube. Its great internal resistance caused the current to leak off elsewhere instead of going through the tube. The next day I attached the same tube to the prime conductors of my own machine and found that its resistance had increased so that it now represented a spark stream of three and five-eighths inches and increased later to nine and one-fourth inches. I determined to thoroughly test the possibility of getting the current through this tube, and with my warm hand as a bridge from the cathode over half of the outer bulb, and crowding the machine to its utmost capacity of current, I succeeded in estab-

lishing the circuit and producing X rays. The process occupied about ten minutes' time.

Despite the very considerable disturbance caused by pushing the current to this extent, the tube did not break or show any signs of being heated above the temperature of my hand that



Author's Crookes Tube in Proper Position for X-Ray Work. *A*, Negative terminal connected by wire to negative pole; *B*, positive terminal connected by wire to positive pole; *CC* are the author's improved interrupters, designed since the first edition of this book was published. The correct position of the tube in the stand upon the table and its relation to the machine are shown in this diagram. The sliding poles are drawn wide apart. A short spark gap is seen between the ball of the interrupters and the larger ball of each sliding pole.

was in contact with it. I first warmed it with an alcohol lamp until the breeze blew out the flame.

To Reduce a High-Resistance Vacuum Through which No Discharge will Pass.—Place the tube in correct connection with the machine for actual work, and carefully apply to the region of the cathode and the outer terminals the heat of an

alcohol lamp moved cautiously over the surface. Have the current in full action, and when the tube is sufficiently heated to lessen the resistance it will usually glow and produce X rays. It is often some assistance to rest the hand upon the tube.

When These Procedures Fail.—The operator will rapidly learn by experience to judge of the state of the tube quickly and will know whether it can be again coaxed to efficiency or must go to the maker—a rare necessity if the tube was right at the start. If, however, coaxing fails for the time being, set the tube aside to rest a few days and meanwhile use another tube. When the rested tube is again tried it will sometimes be as good as ever. It is owing to the fact that all tubes are subject to variations that operative skill is demanded for satisfactory X-ray work. When no effort succeeds send the tube to the maker for repairs.

CHAPTER IX.

THE THREE BEST METHODS OF OPERATING STATIC TUBES WITH LARGE HOLTZ MACHINES.

Convective current method. Oscillating current method. Convective method with spark-gap interrupters. Full description of how to make fluoroscopic examinations. A test piece for comparison of X-ray efficiencies. The fluoroscope.

HAVING a proper tube in hand, or having coaxed a partially altered vacuum to a working point, the three best methods are (1) the convective; (2) with interrupter-spark gap; (3) small Leyden-jar oscillating current.

Sometimes one will prove to be best with a given tube, sometimes another, but the highest type of perfect method with a *finely adapted tube* is the silent, constant, non-heating, convective method.

Convective-Current Method.—Simply connect the tube to the prime conductors, previously drawn apart beyond the sparking distance, and keep the machine in rapid action while desired.

It is difficult to determine that this current puts any injurious strain upon the tube, or tends in any way to break a tube or limit its durability. I usually place the largest jars beneath the pole pieces without making the circuit between their outer coatings. The effect is a possible reinforcement of the current, although when a good tube has been in action I have carefully tested the effects with and without Leyden jars and have failed to notice any difference. The presence of the jars can do no harm, so it is just as well to use them.

To suddenly shut off the X rays or current, when wishing to handle the tube without stopping the machine, short-circuit the

sliding poles. If the tube does not at first glow, bring the poles together till a spark jumps, when it will light up at once.

Oscillating-Current Method.—Connect the tube terminals the same as for the static induced current, with the smallest Leyden jars. Regulate the distance, four, five, or six inches, between the poles, after the machine is in rapid action, by drawing them gradually apart so that the maximum radiance is secured with the image steady. Do not separate the poles so widely that the image will oscillate.

Convective Method with Current Interrupters.—This is the most practical and most certain method to employ. Secure upon the outer rods of the sliding poles of the machine a pair of current interrupters, which are a practical necessity to the static user of ordinary Crookes tubes. They will make a tube of moderate efficiency do good work more quickly and with less trouble than any other way. They cost but a trifle, and as savers of delay, annoyance, and disappointment they are invaluable.

Twist the wires from the tube terminals to the screw rods of these spark devices just above the rubber handles. Place the largest Leyden jars in open circuit attachment to the prime conductors. Draw the poles wide apart. Adjust the ball of the spark device about an inch below each sliding pole. Start the plates into rapid action and lower the ball of each spark piece until the stream to the rods is at its maximum power without splitting.

This drives the current impetuously through about one inch of air space between both the positive and negative contacts, and produces a terrific but fine bombardment within the tube.

These accelerators are extremely useful devices. They make but little more noise than the silent convective method, far less than the Leyden-jar current, and as compared with the break wheel and blower of an expensive coil equipment lately witnessed by the writer in a New York City hospital, the static

Author's Improved Interrupters. Directions for use:—Secure a pair of the above interrupters upon the rubber handles of the sliding poles of the machine with the eyelet outward. Observe that the interrupters are *right* and *left* hand in this respect. Draw the sliding poles of the machine a foot or more apart. Fix the tube by its handle in a proper tube-holder upon a convenient table so that the tube is horizontal and the face of the diagonal electrode presents towards the operator's eye. Hook the wire from the diagonal terminal of the tube (positive in the eyelet of the interrupter upon the positive pole of the machine. Connect the negative terminal of the tube to the eyelet of the interrupter upon the negative pole of the machine. Adjust the sliding handle of each interrupter so that the metallic ball is at first in actual contact with the outer brass ball of each prime conductor. Start the machine into rapid action and observe the tube with the fluoroscope. If it produces powerful X rays without a spark gap let well enough alone; otherwise, slowly draw the sliding ball away from contact with the negative prime conductor until the spark gap is at the point which produces the best X rays. This will vary from about one-quarter of an inch to a full inch in the case of different tubes, and must be determined by test. Next draw away the ball upon the positive pole in the same manner until the tube is working at its best. The spark gap may need to be only on one side (the negative) or may need to be on both sides, with different tubes or different states of the same tube. The exact adjustment is in all cases determined by a moment's test. By means of the long hard-rubber handle the author's improved interrupters may be adjusted with the machine in action without subjecting the operator to sparks from the current. Leyden jars are not necessary in this method.

machine even with Leyden jars is about as soundless as the grave.

Fluoroscopic Examinations.—Secure a few small metal objects—a key, pins, nails, etc.—upon a pine slab about one-half inch thick, three inches wide, and fifteen inches long, for a test piece. Become familiar with its transparency with tubes of varying power, through different intervening bodies, and at all working distances. In the same manner become familiar with the hand and the wrist so that an accurate measure of efficiency can be employed whenever a new tube is selected, or an old tube is being developed to a better state.

All luminous observations, whether for the tube test or fluoroscopic diagnosis, should be made in a darkened room with the eyes accustomed to the dark. This is not imperative for the expert, but it is advisable under all circumstances, and especially so for the untrained eye.

X-ray photographs, however, can be taken irrespective of light or dark, although even here the careful operator will prefer to watch his tube in dim light to be certain of its action.

Having now a tube at work, the object to be examined must be held in front of the tube, and within a very few inches of the tube wall. The exact distance is regulated by the operator's judgment. The fluoroscope is held in the right hand, the eyes are deeply pressed within the opening to exclude all light, and the screen is held in close contact with the hand, limb, body, or object to be examined.

If the screen is not in contact the shadow of the object will be magnified or distorted. The screen can be moved over an extensive part until the entire limb or body is examined, by always keeping the portion of immediate interest nearest the tube.

As nearly as possible the arrangement of tube focus, screen centre, the object, and the operator's eyes, should extend in a direct line. A limb may thus be turned in all desired positions, and as the action of the screen, within its limitations, is quick,

and all positions can be reviewed in rapid order, the fluoroscope is now relied upon for nearly all investigating work.

For record preservation and for the detection of some conditions which the plate will seize upon better than the eye, the negative serves an important and often priceless purpose. A broken needle so embedded that it has bone behind it, and metallic objects obscured by thick bones, such as those of the pelvis and cranium, are far more readily detected by a negative than by the fluoroscope with a feeble tube.

The Fluoroscope.—The pyramidal box of the familiar fluoroscope no longer needs description.

What the lens is to the telescope the fluorescing screen is to the familiar box through which we make an X-ray examination. Within a hundred years there has been a slow but very great improvement in the manufacture of powerful lenses, but the fluoroscope has just celebrated its first anniversary of existence.

Roentgen discovered the X rays through their effect upon barium platinocyanide, but tungstate of calcium was almost exclusively employed in the fluoroscopes used in this country during the past year. It was selected after experiments with every available substance that chemists could procure, and it was very satisfactory.

Those who practically introduced and perfected the tungstate-of-calcium fluoroscope continued their search for a superior chemical. Rumors of impending discoveries appeared in the press, both from Europe and from celebrated laboratories in this country, with such frequency and with such a uniform failure to materialize that they finally became almost discredited and no substitute for tungstate of calcium appeared.

As this book goes to press, however, the author obtains advance information from Messrs. Aylsworth & Jackson, of Orange, N. J., announcing their final success in preparing a new screen of barium platinocyanide which possesses decided superiority.

Two difficulties have in the past prevented the employment

of this chemical. It was both exceedingly difficult to manufacture and exceedingly lacking in durability. The fact that it is also more expensive than tungstate of calcium is not worth mentioning because high efficiency in all X-ray work is always the object of every operator, and quality, not cheapness, is the important thing.

Through the courtesy of Aylsworth & Jackson I have personally tested the new instrument and carefully compared its action with one of the best tungstate-of-calcium fluoroscopes I have ever seen. It gives an increased transparency to opaque objects which may be carefully estimated to equal fifty per cent, and to this extent it enhances the value of any given Crookes tube. I am informed that the question of deterioration has been successfully settled and that the improved screen will last indefinitely.

The advantages derived from such a screen are very great, and, owing to the difficulties in the way, it is probable that the next step of improvement will be a long distance ahead. The best obtainable fluoroscope is as indispensable in X-ray work as the best obtainable Crookes tube, and the best possible electrical apparatus.

Owing to the yellow tint of the barium-platinocyanide screen and its inherent properties, it is not adapted to photographic work and does not displace the tungstate-of-calcium screens now in use for this purpose.

CHAPTER X.

X-RAY PHOTOGRAPHY.

Plates. An experiment for the instruction of the beginner. Steps of process. The negative in position. Watching the tube during an exposure. How to gauge the time of exposure with various tubes. Formula for developer solution. How to mix. How to prepare for practical use. The clearing bath. Technique of manipulating a plate in the dark room. Watching the plate for development of maximum detail. When to stop development. How to rinse, wash, and dry a completed plate. Experimental methods. Detection of pregnancy.

PHOTOGRAPHY is familiar to many physicians who need no further information about it, but to those who have never developed a negative some definite instruction is necessary. The steps are simple, and if a few experimental attempts are first made with inexpensive small plates the process will become sufficiently known to succeed with larger and more important plates. The nearest photographer will be able to give a medical acquaintance the few details of manual technique he may require or even arrange to develop and print the X-ray plates if the operator does not care to handle them himself. This is often the case.

After a varying experience with different plates the author no longer uses so-called special X-ray plates, although they are put upon the market in the most convenient form for the tyro, and it was as a complete novice in photography that I began to use them. Experienced operators usually settle upon some one of the many good plates in the market and adhere to them exclusively. In this way I have finally selected the Seed, *26* X plate, for my use.

Developers are also a confusing subject to the beginner. The formulæ are many, but the one hereafter copied proves to

be satisfactory and enables me to feel confidence in securing details.

Steps of Process.—I will now describe in full a preliminary experiment by which the beginner may acquire familiarity with X-ray photographic work.

Take two small plates, 4x5, and put them at once in a plate-holder large enough to contain them. My own plate-holder will take all sizes up to 14x17, but in ordinary practice negatives of this size are rarely required. If the plates are wrapped in black paper when purchased, they can be taken from the box in daylight and require no plate-holder, otherwise they must be handled in a dark room with a ruby light, or better still none at all. Handle all plates by the edges or glass side only. Do not touch the film side with the fingers. It may be dusted lightly to remove specks, but never rubbed.

Lay the plates on the table with the film side toward the tube without the tube in action. Never bring an unexposed plate into the same room as an active tube. Keep all new plates in another room where no X rays can reach and fog them. With the plates in their holder flat upon the table arrange the Crookes tube above them so that the radiant field will cover the plate perpendicularly. The distance from the plate to the tube may easily be ten or twenty inches with a good tube, or must be reduced by half if the rays are feeble. With the best tube two feet is no more than six inches with an inferior tube as regards exposure time.

Having previously tested the tube and ascertained it to be in working order, take the fluoroscope in hand, darken the room if convenient, and start the machine so as to secure the brightest possible radiance instantly. Observe the action of the tube through the fluoroscope and become so accustomed to doing this that gradually the relation of exposure time to the state of the tube will be familiarly and accurately known.

If the glow is fine and constant, the exposure may be short. If it is ten, twenty, or fifteen per cent below par, the exposure

must compensate in time what it lacks in intensity. Record the time, whether it is half a minute, or one or two minutes, and keep such records until practice makes perfect.

The shortest exposures require the use of a special photographic fluorescing screen between the film and the object, but as this is expensive many do without it. With such a screen and a good tube the hand, wrist, and small objects are secured on the plate in a very few seconds. Even without a screen two minutes or less will produce a perfect picture of every possible detail of the hand and wrist on an 8x10 plate with one of my ordinary tubes sixteen inches distant. I cannot say how long a time would be required to secure a similar picture by such feeble X-ray glimmers as I have seen in some pretentious hospitals and physical laboratories. Poor apparatus never produces fine results even by the most prodigal outlay of time.

As soon as the exposure limit has been reached, stop the machine, remove the hands from the plates, and take the unopened holder to the dark room to develop. Have ready the ruby lamp, two trays, and the following solutions:

Metol Developer.—Solution number one:

Water, ...	ten ounces.
Metol, ...	fifty grains.

Dissolve thoroughly and add—

Sulphite of soda crystals, .	one ounce.

Mix all and filter; label bottle A.

Solution number two:

Water, ...	ten ounces.
Potassium carbonate, . .	one ounce
Sodium carbonate, . .	two ounces

Mix and filter; label bottle B.

Solution number three:

Bromide of potassium, . .	one ounce.
Water, ...	ten ounces.

Mix, filter; label bottle C.

These bottles may be labelled A, B, C, and constitute a per

manent stock. For immediate use, after standing a couple of days, mix in another bottle three parts of A, one part of B, sufficient, to make twelve ounces, and add eight drachms of C.

Pour this developer solution into one clean tray, which should be marked to distinguish it, and never use it with any other solution than the developer.

A new solution will not readily "wet" a dry plate, but we will consider that a preparatory plate has been developed in this fresh solution for the purpose of this experiment. Light the ruby lamp and pour into a second tray the fixing solution of hypo, which must also be prepared in a labelled bottle. It may be simply a saturated solution of hyposulphite of soda, twelve ounces, filtered, or may be any of the formulæ furnished by photographers.

Darken the room and open the wrapper or plate-holder. Place both plates in the developer tray film uppermost, rock the tray instantly, and keep the solution in gentle motion over the plates during entire development. Bring the ruby light near so that all changes in the film can be seen. Note the time. In two or three minutes lift the plates from the tray and look at both sides to become accustomed to the gradual darkening of the film and development of the image. A slow rather than a fast development is desirable when details are sought, and sometimes six, ten, or more minutes are taken for this process by manipulating the solution, although of course much quicker work can be done.

When one plate has become fairly black on the back when held between the eye and the ruby light, rinse it a moment in running water and deposit it film uppermost in the hypo. The hypo tray does not require rocking.

Develop the second plate still longer until it becomes considerably blacker by transmitted light. Rinse and place in the hypo. The developer may now be poured back in the bottle and used again and again.

All development should be begun with a weak solution and the stock bottle gradually becomes weaker with use. It is strengthened from time to time when details do not readily come upon the plate by adding to it a half-ounce or ounce of three parts of A and one part of B, mixed in a graduate before adding to the tray. When it is added to the tray always lift out the plate, pour in the strengthener, and rock the tray to mix the solution before replacing the plate.

If at any time details come too fast, arrest them quickly by pouring about an ounce or less of the restrainer solution C. Then proceed to develop, and a little fresh strengthener can be added if too much restrainer was used.

As the plates remain in the hypo the face which was at first white will gradually darken and in twenty or more minutes will become entirely black. Until the last trace of white disappears, the plates are not fixed. It does no harm to leave them five or ten extra minutes in the hypo clearing bath.

The next step is washing the plate, which must be carefully and thoroughly done. Hold it under a gentle stream of cold water, tilted so that the water will flow over the entire surface for at least fifteen minutes. It can then be left in a clean tray, filled with cold water with a stream running into it, so that the water is constantly in motion for about two hours. Remove, stand on edge in a cool place to dry. A plate requires a draught of air to dry well, but must be protected from dust.

Always drain a plate into the tray from which it comes before rinsing. Always keep solutions cool. Never allow them to mix in the trays. The hypo solution must be freshly made when it becomes weak, but quite a number of plates can be fixed with one bottle of hypo. If at any time a plate frills around the edge, take it out of the plain hypo and add one drachm of powdered alum to harden the film. Then put back the plate and continue fixing. If chrome alum is used in the hypo the film will not frill.

During each step of the process the plate should be watched by the beginner for his instruction and future benefit. When the plates are dry, hold them to the light and note that the first one removed from the developer will lack "density" and be perhaps very faint. The plate which was developed longer will be much better, but to avoid errors of under- or over-development when practical work is afterward undertaken, the beginner should repeat the same experiment with two or more other plates, and in this way learn for himself in the most practical way it can be done the color changes in the plate which mark the acme of result.*

It will be noted in the use of the formula above given that at about the proper point of development the borders of the white side of the plate will begin to turn a brownish hue when examined by direct light. The fullest possible detail will then be visible to the eye and the plate is ready for the hypo.

As the author sends his plates to a photographer for printing and knows nothing about the printing process from practical experience, no attempt will be made here to discuss this final step of the work. Few physicians will care to do their own printing unless they are already experienced photographers, and in this case they require no further suggestions.

The experience and facilities of each physician will also determine whether he wishes to develop his own plates or send them to some one else. If no part of X-ray photography is handled by the physician himself except the exposure, this is so readily done, and involves so little time, when good apparatus is operated by an expert, that there is now no reason why thousands of physicians throughout the country should be without this invaluable process. It may be added that the negative itself constitutes the most perfect record of a case that the physician can either examine or preserve. A print is only required for publication or display, and no print is equal to the

* This is the method employed by the author in instructing physicians.

negative. For this reason none are reproduced in this book. When the novelty of the process is wholly past and negatives are made for practical record only, the great majority of them will be filed away without printing.

During the current stage of X-ray work a variety of methods are being reported which will reach readers through the medical journals and keep them fully informed. They represent but little real advancement, and for the most part offer nothing new. Plans for locating the depth of foreign bodies, of defining internal organs, such as the spleen and heart, by bordering them with a wire for fluoroscopic examination, of employing bromide paper instead of plates, of superimposing a number of layers in one exposure to bring out graduated details, all these and others are utilized by operators in different parts of the country. If the physician is informed of the practical principles of X-ray work as described in this chapter, his own experience and the cases he handles will suggest such other modifications as he may find necessary.

Detection of Pregnancy.—Among the many points of interest in relation to X-ray work none has exceeded the question of the possibility of detecting the pregnant state at any and all stages, especially prior to the third month, and with tumor complications. Owing to the configuration of the pelvis the bony walls prevent a successful examination with the fluoroscope, or the production of a negative, until the state is so far advanced as to make these methods superfluous.

Having given this matter some thought during the early part of last August (1896) I conceived the idea of a vaginoscope for a fluoroscopic examination, and an intravaginal holder in which a segment of bromide paper, which would conform to the parts, could be inserted directly against the uterine wall, and with a tube focussed upon this through the abdomen a photographic picture could be secured. This method would circumvent the interference of the pelvic bones in the path of the X rays, but although I have carried my experiments to the point of appar-

ently establishing the feasibility of the idea, yet the demands upon my time have so far prevented the completion of the instruments. I have tested a working model of the vaginoscope, and at an early date hope to finish the necessary experiments.

CHAPTER XI.

X-RAY EFFECTS IN GENERAL.

High efficiency always desirable. An error of lay writers in regard to the medical uses of X rays. Variations in the intensity of X radiance. The question of "too great penetration." A personal experience in search of a needle. Cause of injurious effects ascribed to X rays really radiant heat rays. Heating effects of coil currents supplied by street mains. X rays do not burn. The electrical effects of long exposures with inferior apparatus. Dermatitis practically impossible in X-ray work with the Holtz apparatus and convective methods. No injurious effects produced by the static current. Therapeutic properties of X rays. No proof that any exist. Electro-therapeutics already possesses all the medical properties sought for in X rays. Specialists in surgical office practice. Small static machines for X ray work when a therapeutic apparatus is not required. About odd-shaped tubes of all sorts, and old models of static machines.

High Efficiency Always Desirable.—When lay writers enter the field of medicine they are seldom accurate. Notwithstanding the fact that the entire force of experimental genius has been, and still is, expended upon the achievement of higher, and ever higher, efficiency in apparatus that will increase the luminosity of X rays and if possible transform them into light, a singular error and contradiction of fact has crept into many published articles in technical journals on this point. Even as late as December, 1896, a leading electrical publication stated:

> It is well to select tubes, and use different tubes for different purposes. A tube of extremely high exhaustion is best for working through the body, but with forearm, hands, feet, etc., this tube has too great penetration, the bones appearing almost equally transparent with the flesh.

Still later on January 21st, 1897, Haskins stated before an electrical association that

> It is quite possible to have too great a penetrative force when using X rays of so great a potential that the difference between the resist-

ance offered by flesh and bone is relatively trivial, with a result that pictures taken under such high intensities lack a sufficient contrast between the flesh and bone; and this cannot be entirely eliminated by shortening the exposure.

It would seem almost unnecessary to say that such ideas are utterly fallacious. It has all along been taught that the intensity of X radiance varies inversely as the square of the distance from the source. And as a matter of fact, if the object examined is removed only a little way from the best tube yet constructed, the radiance diminishes so rapidly that the physician instinctively draws nearer to the tube and gets the object as close to it as he can.

He also instinctively shifts the object back and forth until all positions are tried, and all possible details have been examined. The variations obtainable by moving an object back and forth within the first three feet of the most brilliantly radiant tube that can be discovered will therefore do as much to vary the density of the shadows as would the separate trial of a dozen different tubes at a fixed distance. The physician should always strive to procure the best tubes that appear in the market, and not be misled by the view that a poor tube is preferable for any purpose whatever. The greater includes the less, and the act of Newton in providing a big door for his cat to go through and a little door for the kitten, was as worthy of the philosopher's wisdom as would be the purchase of poor tubes for examining the arm and good tubes for examining the chest.

This curious misconception of the facts of X-ray work obtains in the minds of even some medical men who have already informed me that a tube could be "too penetrating." One operator informed me that one of his tubes gave out X rays which were so penetrating that the "bones totally disappeared," and that even at two feet distance "its penetration was so great that it was impossible to detect a fracture." He seemed to consider such a tube very objectionable, but I have looked in vain for one for some time, and would go a long journey to see

it. After some practical questions about the matter it appeared to be evident that the actual X radiance produced by the tube referred to was really only about such as the majority of good operators are now obtaining. As a reduction in what we may call the "dose" of electricity will instantly lower the X radiance in proportion, and as the radiance is effective inversely as the square of the distance from the tube, we have two ways of regulating ordinary degrees of luminosity.

But I maintain that the tube itself cannot be made too good for general work. The utmost penetration that can be secured still falls short of what is sometimes desired. There are a thousand tubes in actual use which are too poor to give satisfaction, where there is one which is doing fine work, and tubes which are "too penetrating" must as yet be placed in the same category as nuggets of gold which are too big.

Anybody can cut down penetration to any low point they wish by acts which are as simple as the turn of a hand, but to reach a high point of penetration is one of the things which still puzzles almost every operator. The necessity for keen rays is illustrated by the following experience: September 20th, 1896, I was requested to locate a broken needle in the fleshy part of the forearm of a man. I employed a tube of very good efficiency and the fluoroscope, and five minutes of careful search failed to discover any needle.

The man was certain of his facts, and yet an X radiance so brilliant that it would have astonished almost any owner of an ordinary coil apparatus failed to detect the foreign body. A bullet is a very different matter from a needle, and when a fine needle is broken in half and buried deep in the tissues against thick bone, it is difficult to search out with the eye. It is much easier to impress the image of a needle upon a sensitive plate than it is to find it with the fluoroscope, but for several reasons I did not then want to make a photograph and develop it.

As the man was persistent I gave the tube a little more

coaxing and when it glowed with its maximum and really superb radiance the needle was seen above the radius with its point buried in the bone. Had the segment of needle been in relation to the soft tissue only, there would have been no trouble in finding it, but as it was directly upon the bone in the thickest part of the forearm it did not present itself to the eye until the shadows behind it had been cut down by an extremely bright radiance.

Giant Coils.—Mention is frequently made in current literature of this date of twenty-inch spark coils and giant devices containing many miles of wire. These extraordinary coils are an attempt to reach exceedingly great efficiencies in X radiance. One such reported apparatus is constructed in a great steel mill for tests upon armor plates. These reports have been exceedingly interesting to the author, but in no case does any information obtainable indicate that the generation of X rays exceeds the product of the Holtz machine with a suitable tube.

The simplicity of the Holtz machine gives it a great advantage over these giant coils, and unless it can be demonstrated that effects of great superiority are produced by the costlier and more difficult apparatus, it can hardly be worth while to employ them. At the date of this writing I feel willing to state my conviction that the powerful static machine will outclass even these magnificent and great coils, but I shall retract this statement whenever evidence to the contrary reaches me. In the great steel works near Pittsburg heavy plates of armor have been photographed through by X rays in two hours, and thin plates have been penetrated by the rays in ten minutes, but the description of the process which reaches me does not indicate any greater X radiance than I have demonstrated in my own office regularly during the past six months.

Cause of Injurious Effects Ascribed to X Rays Really Radiant Heat Rays.—In closing these remarks the author will again refer to the point about which some physicians have

expressed alarm. A correspondent of the *Medical Record*, February 7th, 1897, writes as follows:

It has been my fortune to observe certain cases of dermatitis, loss of hair, etc., in patients who had been exposed to the action of X rays. Numerous other instances of burning, depilation, and bleaching have been reported by different observers. These annoying and unlooked-for accidents tend to lessen the frequency of resort to a method of investigation which I believe is too valuable to be thus limited.

The writer quotes Tesla to the effect that:

Since I made those statements I have gained additional evidence that the X rays themselves are incapable of producing the actions reported, and that they are due to ozone and possibly nitrous acid. I wish to add that also heat may be to a certain extent responsible. The effects always follow long exposures at a short range, and the long continued heat may cause desiccation of the skin with subsequent dermatitis.

The above expresses one of the numerous reasons why the use of heavy currents, ordinary coils, and inferior tubes have proved to be unsatisfactory for medical work. The fact that the X effects puzzle almost every operator who observes them, and that when I first declared their true explanation seven or eight months before the above statement from Tesla (in July, 1896) I stood practically alone in my opinion that they were not due to X rays, emphasizes the great dearth of electro-therapeutic information, and the unfamiliarity with the teachings of electrophysiology among the medical profession.

Had every medical college during this generation taught its undergraduates what has been known for fifty years about the electrolytic and chemical action of the galvanic current, there would have been no misunderstanding about the matter.

The current from the static machine has long been known to be of immense electric high voltage and minutely small amperage, without chemical effects. With a proper Crookes tube it generates the most brilliant X rays without warming the tube beyond blood heat and since it will make X ray pictures with

very short exposure, with the tube at long distances as compared with the average coil, it is obvious to every student of electro-physiology that X rays from the static machine are unlikely to cause hair to fall out, or heat a body ten, fifteen, or twenty inches distant any warmer than they heat the tube through which they pass. As an object-lesson on this point, place the hand upon a static tube glowing with its maximum of brilliant radiance, and the other hand upon a sixteen or thirty-two candle-power lamp bulb, with the street current on. No other comment will be necessary. As a matter of fact the platinum reflector in a tube glowed with a coil is generally heated a cherry red, while it may be run consecutively day and night with the static machine, and a proper current, regulated to such a tube as the author uses, without producing this redness at all. The rays which cause dermatitis are evidently the old radiant heat rays discussed by Crookes.

Paragraphs like the following have gone the rounds of the medical press:

> Dermatitis Roentgeni is often of too serious a nature to permit of the employment of X rays in reckless therapeutic experiment.—"*Therapeutic Hints*," *Medical Record, February 27th*, 1897.

Owing to the persistence and capacity for error of an extensive circulation in printer's ink, it is probable that generations of physicians yet to come will believe with a patient of mine, who said but yesterday, "X rays burn. I know they do. The papers say they burn." There is a certain amount of harmfulness in the propagation of alarm and timidity on this subject which renders an explicit understanding of the truth desirable.

For the purpose of definiteness in disposing of a popular error that arose out of experimental ignorance and should be relegated to prompt oblivion, I copy in detail from the New York *Medical Journal* of Feburary 27th, 1897, an illustrative report of a case of "Dermatitis from Exposure to X Rays."

> In the February number of the *Scottish Medical and Surgical Journal*, Prof. E. Weymouth Reid, of Dundee, relates the following case

which occurred in his own person: Having to deliver a lecture on Roentgen's discovery, he wished to obtain a photograph of his own chest and abdomen through the clothing, to exhibit the contents of the pockets in addition to the skeletal stuctures. The exposures to which he was subjected were as follows: The abdomen, on November 2d, twenty minutes, followed by another exposure of forty minutes. The chest, on November 3d, fifty minutes, followed two days later by an exposure of ninety minutes. The coil was of ten-inch spark fed by ten amperes, and the Crookes tube ("focus" pattern) was some three inches from his waistcoat as he lay upon the table.

On the evening of each exposure marked erythema of the skin on the abdomen and chest was noticed immediately beneath the position of the vacuum tube, and, in addition, slight redness of the skin of the back over an area corresponding to the exit of the rays from the body. The professor at once began to rub in lanolin and continued to do so for the next twelve days.

Vesicles soon appeared, continues the author, and gradually coalesced, so that by fourteen or fifteen days the cuticle was loose. On the back vesicles also were formed, but soon subsided.

By seventeen days the cuticle began to peel off, leaving a surface exactly like that seen when the cuticle was rubbed off a dissecting-room subject, except that it was of a bright-red color. The peeling of the skin of the chest, in correspondence to its time of exposure, was about two days later than that of the abdomen.

The surface left was "raw" and "weeping," but not very painful. It was kept well dusted with powdered talc and protected from the friction of the clothes by a pad of wadding.

The author states that the discharge next became sero-purulent and that he had now lost some thirty square inches of cuticle, and must have been daily losing considerable amounts of albumin in the discharge, and it was with difficulty that he attended to his laboratory duties.

However, by twenty-seven days the surface was dry, and in thirty-three days quite healed.

On January 11th, 1897, there was no vestige of hair left upon the chest, and he has not been troubled with the shaving of his chin for the last six weeks, the hair having come out by the bulbs to the touch of the razor twenty-two days after the chest exposure, after a slight preliminary erythema of the skin not followed by loss of cuticle.

The above report is sufficiently typical of most cases of the occurrence. The exposures were twenty minutes, forty minutes, fifty minutes, ninety minutes, a total of three and a half

hours. The "coil was fed by ten amperes of current, and the tube was *three inches* from his waistcoat."

The mere relation of these facts condemns both the operator and the apparatus, and places them in exactly the same category as the man who would swallow a drachm of the tincture of aconite for a medicinal dose of a fraction of a minim. The medical profession would not feel any responsibility for the consequences.

Operators to-day with good coils publish the previously cited list of exposure times, and have no occasion to report cases of dermatitis caused by good apparatus and proper methods.

Shoulder, ten to fifteen minutes at ten inches.
Thorax, fifteen to thirty minutes at ten inches.
Hip-joint, thirty to forty-five minutes at fifteen inches.
Stone in kidneys, thirty to forty-five minutes at twelve to fifteen inches.
Glass, iron, lead, etc., in any part of the trunk, thirty minutes on an average at twelve to fifteen inches.

Even with these proximities to the tube the patient is probably safe, but when in addition the Holtz-machine current is employed instead of the "ten-ampere street current," the last possibility of dermatitis is abolished. With the large static tubes which I have described elsewhere, I can double the above distances between the object and the tube in photographic work, and while the few seconds of time which secures results with shorter distances is lengthened to about two minutes when there is about twenty inches between the hand and the tube, yet two minutes is too short a time to impress the skin with any burning effects, even with the street current.

Moreover the static current cuts down the exposure time for the trunk far below thirty minutes. I have now an eight-by-ten negative of a portion of the upper spinal column of a man, aged thirty, which shows the ribs and spine with sufficient distinctness for purposes of demonstration. I measured the distance between the reflector and the negative sixteen and a half

inches, omitted any fluorescing screen, and stopped the tube (not a very good one) with exactly one minute and thirty seconds' exposure, for a test February 24th, 1897. The plate was of course under-exposed and required careful developing, but illustrates that if prominent medical journals would inform themselves of the facts and cease to circulate the consequences of inexpert or injudicious handling of heavy electrical currents as the effects of X rays, a great deal of confusion about the matter would be avoided.

While there is no mechanical device which cannot be abused, yet if any physician with a Holtz machine and one of the author's tubes would start out in the morning with the deliberate purpose of inflicting upon himself "dermatitis Roentgeni" by nightfall of a long summer's day, he would probably be baffled in the attempt if he employed the proper method.

In closing these remarks a brief reference to a prophylactic suggestion from an eminent dermatologist is appropriate as an instance of the tendency of some medical minds to take the long journey around Robin Hood's barn to reach a nearby end. "Dr. —— makes the suggestion that as prophylactic workers with these rays might wear red cloth gloves or coat their hands and face with red paint which could be easily washed off."

My own suggestion would be to use apparatus of sufficient working capacity to permit short exposures, as well as a form of current which has no electrolytic action. It would be difficult to estimate the number of hours of experimental work during which the back of my own hand has been in close relation to the different tubes I have tested with a static machine. No sign of any effect whatever has been apparent, and I can maintain actual contact between the palm of the hand and the bulb of the tube for any length of time with impunity.

Summarizing the exact state of the case as it appears to the writer, radiant heat, chemical, or electrolytic effects of dermatitis, etc., are produced during exposure to X rays when said rays are excited by electrical currents which produce identical

effects without X rays. The direct static discharge of high potential and infinitely small amperage does not produce electrolytic or chemical effects upon the human tissues without X rays, and consequently does not produce such effects in conjunction with X rays.

Nothing that has yet been reported as a physiological, pathological, or therapeutic effect of X rays appears to indicate any peculiar action in these rays other than the well-known actions of the electric current which excites them. It is probable that the above view will presently be universally accepted.

Therapeutic Properties of X Rays.—At an early period of scientific inquiry into the nature of X rays, and especially when it was found that their most practical application was to aid the surgeon in diagnosis, it was inferred that they might possess therapeutic properties.

This phase of their action may well be one of interest to the medical mind, and for more than a year I have carefully followed the various reports upon the subject. These reports chiefly relate to laboratory tests upon microbe cultures, and represent the least reliable side of medicine to-day. Bacteriology is, except in rare instances, the most unsafe guide that clinical therapeutics can attempt to follow, and to the practical student of medical electricity it seems impossible to discover any serious basis for regarding X rays as curative agents.

Few, if any, suggestions of medical properties have come from leaders in electro-therapy. My own conclusion is that X rays do not possess any particular therapeutic properties; that alleged actions upon disease germs result from the electrical current employed and other natural causes; and that any possible actions that may reside within the X rays themselves are already at our command in the established procedures of galvanic, induction-coil, and static medical currents.

No other view seems to me at all tenable. All that is claimed by sensational exponents of X-ray therapeutics seems very commonplace and familiar to the trained electro-therapeu-

tist. Roentgen's report has stood the closest examination and is to-day one of the masterpieces of exact statement. Those who jump at conclusions before reading it find afterwards that the original discoverer very thoroughly cleared the ground before he gave his message to the world.

From the study of Roentgen's report, upon which there has been no great scientific advance, and from the consideration of electro-physical, physiological, and therapeutic effects, it seems impossible to seriously consider any medical relation of X rays to disease separate from the action of the current which excites them. Their excitation within a Crookes tube is associated with three types of current—induction coil, high-frequency coil, and static—and all the therapeutic properties of these currents have been fully available to medicine for a number of years. From time to time there springs up some minor innovation upon the chief varieties of electro-medical currents; but in the author's opinion—here very confidently expressed—the physician who possesses a proper galvanic battery, high-tension induction-coil apparatus, and large Holtz machine, can cover the range of all the non-surgical applications of electricity to the treatment of human disease.

If the X ray possessed any or all of the properties which bacteriologists have been attempting to discover within it, nothing would be added to the present resources of medical electricity.

Specialists in Surgical Office Practice.—In direct conversation with the author, and in some of my correspondence, surgeons are inclined to repudiate the idea that they need an X-ray apparatus that is therapeutic. Do not make this mistake. The day will come when the most frequent employment of the once neglected static machine will be in the surgeon's office.

The X ray is for the most part the necessity of the surgeon rather than of the physician, and only a little study of the static machine, or the employment of an assistant who can handle the

electrodes, will add to the practice of the surgeon's office a line of now discarded clinical work of indisputable importance and of great lucrative possibilities.

This book was not prepared with any thought of setting forth the direct surgical bearings of static therapeutics, but those whose practice deals with patients of a surgical character will find ample suggestions to their advantage in the chapter on electro-physiology.

If the X-ray discovery makes a revolution in the possibilities of physical examination and diagnosis in surgical work, it also promises to open to the surgeon's eyes a great opportunity to benefit his patients which he has hitherto for the most part turned away.

The section of this book comparing massage with the resources of electro-therapeutics will be found suggestive to those who are in the habit of referring cases out of their own hands.

Small Static Machines for X-Ray Uses.—I deem it obvious, and not open to argument, that a physician in medical practice who can obtain X rays of the highest efficiency from an apparatus which will also earn him much money by its valuable therapeutic properties, will prefer to do so, rather than purchase an apparatus of any kind which is useful for X rays alone.

However, for the advantage of physicians in special lines of work without opportunities for employing electro-therapy, and for schools, laboratories, and experimental uses a smaller static machine of the Toepler-Holtz model is being largely sold for exclusive X-ray work. It costs about one-third or one-fourth the price of either the therapeutic static machine or a fine X-ray coil, and it produces as good or even better results than the average spark coil, with clearer and sharper definitions. It is furnished with ball bearings and a high gear so that in the absence of motor power it can very rapidly run by hand.

It should be again stated, and it cannot be too thoroughly

understood by physicians, that among the great advantages possessed by all types of static machines when the operator possesses tubes adapted to them are: 1. Heavy currents may by accident burn out Ruhmkorff coils, and a burned-out coil is nearly a complete loss. A static machine cannot "burn out." 2. With proper static methods the liability of destroying tubes is reduced almost to zero, and the saving of cost by this fact is a large item. 3. In brightness of radiance, clearness of detail, and sharpness of definition the superiority of static-machine work is very great if the correct tube and method are employed.

The small machines cannot equal the twenty-six and thirty-inch Holtz machine. They necessitate condensers and hence are noisy. They furnish the least costly means of producing a fair X radiance, but are not for a moment to be regarded as an equal substitute for the larger apparatus I employ.

About Odd-Shaped Tubes of All Sorts, and Old Models of Static Machines.—Since the publication of my article on Crookes tubes and static machines in the *Medical Record* of February 6th, 1897, I have received a large number of inquiries from physicians who write to know whether they can use static machines with plates of sixteen, twenty, or twenty-five inches in diameter, and of models which would now be called very old-fashioned and inadequate for therapeutic purposes. Other inquiries relate to the style of tube, and to illustrate some of the difficulties with which physicians are now contending I append a few lines from one among a great many similar letters which have reached me:

> I write to you for advice concerning my troubles in my X-ray work. . . .
>
> The tube did good work the first few times I used it and then met with some accident, presumably by spark discharge. What now troubles my soul is to find another tube like the first. . . .
>
> In S——, it is utterly impossible to secure decent tubes. The local dealers are pushing the sale of every old thing in the way of a tube you can imagine. I have a beautiful collection of tubes of most fantastic shape, size, and thickness, from the size of an egg to

a football. Some of them would no more allow of the development of X rays than a cow give birth to a kitten. I don't believe a rifle ball would pass through some of them, while others are not even Geissler tubes.

I shall try to assist my professional colleagues who are in a similar quandary by here setting forth the facts.

All the static machines of four or six plates, and sixteen or twenty inches in diameter, which were sold prior to the year 1885 are perfectly available for X-ray use.

If the machine is in perfect order it is ready for work. If it is not in order and has no means of charging, the owner may have it cleaned at a small expense and purchase a small Wimshurst charger separately for a small sum.

The proper tube will be the same model employed with my large Holtz machine but of a smaller size and a relatively lower vacuum. They can be obtained from the same makers.

In operating the machine the owner will require some means of making the plates turn rapidly, and if no motor power can be supplied a new hand-wheel could be made to gear up the machine on the same principle as the bicycle, so that hand power would then turn it very fast. This makes clear the feasibility of the small machines. Each operator will do well to purchase a pair of the interrupters or spark attachments to which I have referred in another place.

The eccentric experiments in Crookes tubes during the process of working out the solution of the problem of shape resulted of course in putting a great many tubes on the market which are now very inferior. The whole question of tubes can be best settled by excluding other shapes and adhering to the design illustrated in this book. Not only are none others equally satisfactory, but many tubes of small size possess so little room within the bulb that slight changes unfit them for further use.

It is a common experience to have a small tube work well the first day and afterwards prove useless. Tubes are too expensive to buy daily, and such uncertainty of action is absolutely

needless. This lack of capacity to permit reasonable alterations in vacuum state is the fatal defect of small tubes. Another defect is their liability to spark between the outer terminals and the internal electrode, when used with the static current. This will often produce a puncture. Still another defect is the impossibility of separating the wires far enough to avoid leakage, when the total length of the tube is only six inches. Other defects of some of the small tubes relate to

The design of the author's improved Crookes tube for use with the static machine is beautifully illustrated in the above figure. These tubes are now supplied by Van Houten & Ten Broeck, No. 300 Fourth Avenue, New York City, in two qualities, both of which are guaranteed to be satisfactory to purchasers. The success of my efforts to standardize the tube and its vacuum has enabled the makers to furnish a guaranty of quality. Each tube of ordinary vacuum is guaranteed to glow quickly and maintain brilliant and steady radiance when operated according to my directions, and is guaranteed not to puncture during proper use with the static machine. The extra quality tube, possessing a tested and guaranteed high efficiency, is designed to supply a demand from specialists and expert operators who desire maximum X-ray effects. This quality possesses a high vacuum and is therefore designed only for operators who are sufficiently skilled in tube manipulation to overcome the usual variations to which all tubes are subject. So far as I am aware these tubes continue to be superior to any that have yet been brought to my notice.

their great liability of breakage, although the static current does not break proper tubes.

Some of them also are so inconveniently fitted with a handle that they cannot be manipulated easily in a variety of positions.

These defects are all separate from the question of vacuum and external projection of X rays. Many of the peculiar tubes in the market project rays but a short distance in front of them, although they may be exceedingly bright at close range. The matter of vacuum has been so fully presented in a previ-

ous chapter that the reader can easily test any tubes that he may have on hand.

Passing from the question of the disadvantages of the medley of Crookes tubes produced during the year 1896, let us consider briefly the particular advantages of the Crookes tube preferred by the author.

It is eleven or twelve inches between the terminals; the bulb is about five inches long by about twelve and one-half inches in circumference, and consequently contains sufficient space to allow a large margin of internal alteration in vacuum without becoming useless.

Its contour enables it to project rays to the greatest possible distance.

Its radius of action covers the widest range.

It is substantial and not easily broken by accident. I have never broken one in operative work.

Its handle is the most convenient of any I have ever seen.

It is large, strong, and can be arranged in any position in the tube-holder.

If the vacuum is right at the start, the tube remains in practical working order permanently until accident may destroy it.

The alterations liable to all tubes rarely prevent this tube from working properly after a few moments' preliminary manipulation. These are not theoretical statements but are based upon the author's experience with a considerable variety of tubes, many of which have been sent to me for special test purposes.

My experience with the preferred tube developed for special static work began seven months ago, and my conclusions are as fully settled by actual experience as anything can be settled in this field of work. All that is said in these chapters about my own X-ray work is extremely conservative, and in actual demonstrations I have regularly surpassed the results that I have reported.

Every physician who comes to me for X-ray operative instruction voluntarily admits the truth of this statement.

CHAPTER XII.

ELECTRO-PHYSIOLOGY.

The actions of static electricity in various forms of application. The importance of familiarity with this branch of the subject. Action upon functions. The chief properties of static electricity determined by scientific investigation before the discovery of galvanism. Cavallo's accurate report. Sedative effects described by Arthuis in 1871. Static electricity as a regulator of functions. Its nerve and muscle reactions. Its effects on metabolism and nutrition. Mechanical effects of the spark. Vasomotor effects. Revulsive effects. Sedative *versus* stimulating effects. Relief of pains. Its great service in nervous and functional conditions and all diseases associated with malnutrition. Its action upon the deeper tissues of the body. Its great penetrating capacity. Leyden-jar currents. Their physiological actions similar to currents from improved induction coils. Rapid and slow interruptions and nerve and muscle effects. How to determine the difference between large and small jar currents by actual test. A comparison of Leyden-jar currents with induction-coil currents in practical use. Length of *séances*. Principles governing same.

The Actions of Static Electricity in Its Various Forms of Application.—No physician of any school can forget his careful training in the important subject of drug action. He may happily forget something about anatomy and relieve his mind of one of the worst bugbears of his college course, but familiarity with drug action must be continuously cultivated throughout every year of medical practice.

It is equally self-evident that familiarity with electric current action upon and within the living tissues is a basic need to the physician who prescribes an electric current therapeutically. Post-graduate study of this subject forms the chief present resource of the practitioner desiring knowledge, but undergraduate schools are slowly taking up the work.

The physician requires facts about electricity for practical medical use and not for mere diversion or prejudice. Among

such facts those relating to current action are of fundamental and never-ceasing importance.

The constitutional effect of simple static electrification depends upon existing deviations from normal within the tissues subjected to the action of this current. Just as aconite cannot break a fever in the case of a patient who has no fever, so the static current cannot manifest its predominant action as a regulator of deranged functional processes of the nervous, circulatory, secretory, and muscular systems in cases which are already normal. A healthy man will observe little effect from a static administration which would warm, energize, compose, and relieve from a dozen accompanying symptoms a patient who had the symptoms to relieve. This may be very elementary teaching, but experience proves that no fact, however simple, can be made too plain.

Endowed with high potential, and extremely small in volume, the physiological effects of static electricity are chiefly modifications of the ordinary vital processes without electrolytic alterations. Static electricity may increase, diminish, arrest, or otherwise modify these functional processes. It affects secretion, excretion, absorption, reflex action, sleep, respiration, circulation, and nutrition. Owing to its enormous electro-motive force and its power of condensation and accumulation, it possesses great diffusiveness, which enables it to affect the entire system in a limited degree.

That static electricity had a decided influence upon the physiological functions is not a discovery of our own times, but was observed before galvanism and faradism were dreamed of. In a work written previous to 1790 we read the following remarks on this subject:

> Electricity, strongly communicated to insulated animal bodies, quickens their pulse and promotes their perspiration. If it is communicated to insulated fruits, fluids, and in general to every kind of bodies that are actually in a state of evaporation, it also increases that evaporation, and that in a greater or less degree according as those bodies are more or less subject to evaporate of themselves, or

as the vessels that contain them are conductors or non-conductors and as they have a greater or less surface exposed to the open air. By increasing the perspiration of vegetables electricity promotes their growth, it having been found after several accurate experiments that such plants which have been often and long electrified have showed a more lively and forward appearance than others of the same kind which were not electrified.

In 1777 and 1781 there were published in London editions of a treatise on medical electricity, by Tiberius Cavallo, F.R.S., in which is recorded all that was known in his time of the subject in hand. The discerning observations here quoted were made at least ten years before the first foreshadowing of Galvani's discovery of a current with chemical and electrolytic properties; and they are not only remarkable for their accuracy, but for the fact that very little has been added to them since. Mr. Cavallo recites as follows:

The remarks made by philosophers relating to the effects of [static] electricity upon the human body in general are the following, viz., that *by electrization, whether positive or negative*, the pulse of a person is quickened, the number of pulsations being generally increased about one-sixth; and that glandular secretions and the insensible perspiration are promoted and often restored when they have been entirely obstructed.

It might naturally be suspected that the promotion of perspiration and of glandular secretion was only the consequence of the accelerated pulse and not the immediate effect of electricity; but the contrary is easily proved by observing that in various cases the quickening of the pulse by other means, as fear, exercise, etc., does not promote those secretions nearly so much, if at all, as electrization, and also the glandular secretions and perspiration are often promoted by electricity when applied only to a particular part of the body, in which case it seldom, if ever, accelerates the pulse.

Hitherto it has not been discovered that [static] electricity acts within the human body by any chemical property, as most medicines generally do; but its action by which it produces the abovementioned effects may be considered merely as a mechanical stimulation, for it seems to act as such even within those parts of the body which, especially when diseased, are mostly out of the reach of other remedies. . . .

From these observations it appears that the application of [static] electricity does not merely promote any discharge or circulation of

fluids, but rather *assists the vis vitæ*, or *that innate endeavor by which nature tends to restore the sound state.*

It may, perhaps, be ever difficult to explain in what manner electricity assists that natural endeavor, but experience shows the certainty of the fact, and with it we must be gratefully content; for we may apply the effects to our wants, though we may be ignorant of their cause and mode of action.

When an electric shock is sent through any part of the body, an instantaneous involuntary motion is occasioned, which shows that the muscular fibres through which the shock is sent are expanded or in some other manner convulsed. This involuntary motion is also occasioned by sparks.

Further, when a shock is sent through several substances besides the human body, a tremulous motion and an expansion is evidently occasioned, as may be shown by many experiments.

Now all these observations may perhaps in a manner explain the action of electricity upon the organized parts of an animal body by comparing it with the tremulous motion given to tubes of any sort through which fluids are transmitted, in order to accelerate their passage or prevent any stoppage or stagnation which might occur.

In my essay upon medical electricity it is mentioned that from the experience of many it appeared that electrization increases the number of pulsations about one-sixth; but having made many experiments upon myself, I added the following observation in the second edition of my essay in the year 1781, and consequently long before Mr. Van Marum's experiments: "I do not remember that my pulse was ever evidently accelerated by electrization, and yet I have tested the matter at various times and with great diversity of circumstances. In another essay I have stated that by repeated experiments, accurately made by Mr. Van Marum and other ingenious persons, it was found that electrization, whether *positive* or *negative*, did neither sensibly augment nor diminish the natural pulse rate in a healthy man. Upon the whole, therefore, it seems to be ascertained that electrization does not increase or retard the ordinary number of pulsations, and the increase generally observed before may have been due to fear or apprehension. But I am now informed by Mr. Partington, who has long practised medical electricity, that electrization, if not in a sound, at least in an unsound state of the body, augments the number of pulsations considerably."

I will here mention a few hints which may promote the investigation especially of the chemical action of electricity, viz., if it adds any principle to those through which it passes as an acid, an alkali, the inflammable principle, etc.

The observations relating to this point are first, that when any

part of the body has been exposed to the stream of electric fluid it acquires a sulphurous or rather a phosphoric smell which it retains for a considerable time; secondly, when the stream of electric fluid, issuing from a point, is directed toward the palate, a kind of acid taste is perceived.

Now this smell and taste indicate that the electric fluid either alters the parts of the body upon which it excites those sensations or that it carries along with it some other principle which may perhaps be separated from those substances through which this fluid passes previous to its impinging upon the body.

Whether these effects may be increased, diminished, or turned to any use, and also whether they are quite indifferent with respect to medical electricity, are matters that require further experiments and consideration. In various experiments when the electric spark is passed through air or other fluids, especially in the case of tinctures of certain flowers, it shows effects similar to those which the inflammatory principle or an acid produces upon those fluids. The facts have induced various persons to suppose that the electric fluid is phlogiston or an acid, or else a compound of both. But considering that in those cases the action of the electric fluid as an acid or as phlogiston is exceedingly small, and also considering the violence with which it passes through the substance of bodies, the surface of which it usually burns or melts in a small degree, it seems more natural to suspect that the above-mentioned effects are produced by that quantity of inflammable or acid principle which the violent passage and escape of the electrical fluid detaches from other bodies rather than to consider electricity itself to be an acid, which seems to be very unlikely on various other accounts.

It is customary in this age of aggressive bacteriology to discredit the "quacks" (*sic!*) who were the pioneers in electro-therapeutics, but that Tiberius Cavallo, F.R.S., was a scientific and discriminating observer and not an ignorant empiric is evident from the mere list of his literary productions which is affixed.*

* 1. "A Treatise on the Nature and Properties of Air and Other Permanently Elastic Fluids" to which is prefixed an Introduction to Chemistry," 4to, with plates.

2. "The History and Practice of Aerostation," 8vo, with plates.

3. "A Treatise on Magnetism in Theory and Practice with Original Experiments," 8vo, with plates.

4. "Two Mineralogical Tables with an Explanation and Index."

5. "Description and Use of the Telescopical Mother of Pearl Micrometer Invented by the Author," 8vo.

6. "A Complete Treatise on Electricity in Theory and Practice, with Original Experiments," in three volumes.

About a hundred years later a French writer, Dr. A. Arthuis (1871), summed up the physiological effects of static electricity as follows:

> It induces an acceleration of the pulse, it is singularly *calmant*, eases the respiration, develops animal heat, augments cutaneous transpiration, makes more active the urinary secretion, disperses nervous irritation, and gives tone to the whole organism. It is the great dispenser of equilibrium to the disturbed balance of the system, it increases the vital forces, and augments the energy of absorption. In a word, it excites and facilitates the play of all the functions. It is regarded by those who use it as the greatest regulator of menstruation. The well-being which it instantaneously produces causes those who have once experienced it to wish for a repetition of its beneficent effects.

When, one hundred and forty years ago, it was discovered by the Abbé Menon that the human body loses weight by being continuously electrified for five or six hours, he attributed the loss to the increase of insensible perspiration and tissue change. We now say about the same thing in somewhat different language.

The teachings of modern investigation upon this subject may be fairly stated in the following terms: Static electricity increases the excretion of urea, and lessens the uric acid in the system by promoting oxidation. It increases both the appetite and the body weight when the latter has been reduced by impaired nutrition. It lowers the blood pressure. In ten to fifteen minutes of general electrification, or a few minutes of sparks to the spine, a gentle perspiration ensues, accompanied by a feeling of well-being. When this reaction has been reached the sitting may be ended for the day, in ordinary treatment.

Under the influence of static electricity the heart-beats undergo a change, viz., if slow, they may increase ten to twenty beats per minute; or, if too fast, they may be reduced in number. It tends to regulate functionally deranged temperature. Many cases of neurotic, neurasthenic, and melancholic conditions are found to have subnormal temperatures (97° to 97.5°

F.) before electrification. These states it adjusts to normal, and the patients then usually improve.

The static spark causes groups of muscles to jump. It is a most powerful stimulus to nerve and muscle function, and rapidly imparts tonicity, lightness, buoyancy, and firmness to soft, lax, and enfeebled muscular substance. It first causes a vasomotor constriction, blanching the skin. This soon gives place to a dilatation, and the spot gets red. Frequently a wheal is raised, with a temporary sense of tingling and irritation, which will quickly pass away or be instantly removed by rubbing the part with a little toilet powder. If sparks are applied with sufficient persistence to the same area, a mild papular eruption will often be caused.

Devoid as it is of electrolytic action, the power of static electricity seems to be chiefly manifested as a regulator of *functions*. It tends to adjust to normal action the heart, respiration, pulse, temperature, oxidation, secretion, excretion, nervous irritability, and sleep. It increases metabolism so that a person can absorb more oxygen: and this mere improvement in nutrition is a vast power for good, and alone suffices to correct many morbid states: as gout, rheumatism, neurasthenia, neuralgia, anæmia, and various symptomatic derangements.

The spark, by its powerful mechanical disturbance, sets up a great molecular change and acts as a stimulating massage. It thus affects the nutrition of a part, disperses exudation material, and promotes absorption. Thickenings of joints, tendons, and muscles, localized œdemas, effusions, etc., are reduced by strong, thick static sparks.

With fine, rapid, frictional sparks may be obtained the beneficial effects of counter irritation upon the skin; and with a special electrode a blister may be created in from one to four minutes, if desired.

Sedative or stimulating effects are equally under the operator's control, and may be obtained at will.

Many varieties of pain are promptly relieved by some form of static electricity; and if not due to an incurable or persisting cause, it is wellnigh certain that the pain-killing property of this agent will give permanent relief, if treatment is persevered in long enough.

As a concluding summary of modern opinion upon the action of static currents, I will repeat here an abstract of the report of the committee on "Standard Electrostatic or Influence Machines" presented to the convention of the American Electro-Therapeutic Association, and published in the *Times and Register*, December 29th, 1894:

The committee stated that the report was one of immense comprehensiveness and could only be scratched on the surface in the short time allotted. The physiological effects of static electricity are pretty much all that are produced by all electricity. It sets free the potential energy of the cells of the human organism. That is, it excites the cell in such a way that its inherent energy is liberated. Its wide range of effects vary with and depend somewhat upon the manner in which it is applied.

It causes contraction of the protoplasm, both animal and vegetable. It excites nerve fibres, nerve cells, and nerve centres. All of them are excited to functional action and caused to produce their separate effects—motor, sensory, special sense, secretory, sympathetic, vasomotor, etc.

It has a mechanical action. It disturbs the molecular arrangement of tissues and causes a new structural arrangement, resulting in modifications of nutrition.

It has a cataphoric action and can be made to transfer metals and convey medicaments into the tissues.*

Its general effects are of great range and astonishing importance. They may be briefly stated as follows: It promotes nutrition of every part it excites; produces marked local and general circulatory effects, and stimulates the vasomotor nervous system. It promotes metabolism and tissue metamorphoses; creates a feeling of refreshment to the system; causes the reabsorption of exudation material of a chronic nature and has a revulsive action upon the skin. It is both a cutaneous sedative and counter-irritant, and

* In 1872 Arthuis described metal transference and advocated the use of silver, iron, and other metals in the usual electrodes. Practically no use is made of this suggestion.

makes a powerful peripheral impression of great value in neurasthenia.

The subject of reflex pains is of constant interest to a physician. Pains are often referred by patients to points distant from their origin. Possibly a pain travels along the path of least possible resistance, and in its outward path it prepares the way for the return of a curative influence along the same path. No matter how far from the local irritation a reflected pain may manifest itself, spark the sore place and the impression will track the pain to its seat and drive it out. We cannot cure altered structure, but we can correct functional pains, and often relieve organic pains by setting up powerful ingoing impressions and displacing the pain.

The list of diseases in which static electricity can be beneficially employed is a long one. Its great fields are nervous and functional conditions. In cases of malnutrition it is an excellent tonic. Neurasthenia, hysteria, neuralgia, nervous headaches, etc., are rapidly controlled by it. In cord diseases it affords relief from various forms of pain, even when lesions are advanced beyond cure. It is invaluable in muscular rheumatism, chronic synovitis, and chorea. It is one of the best general tonics we possess, and as such is easy and agreeable of application, and can be used in a great variety of cases. In the treatment of paralysis of curable forms it is one of the most successful agents we have.

It should be noted, however, for the better understanding of those who are not practical electricians, that these interesting effects attributed to static electricity are neither invariable nor absolute, but depend upon and are influenced by concomitant conditions, just as drug action varies under different circumstances. For instance, in a cold office, and with a patient with habitually cold extremities and lack of vital warmth, we may discover little sign of the perspiration spoken of. It may therefore be stated that the demonstrable physiological effects upon any given case will be modified by the individual idiosyncrasy of the patient, the apparel worn, the state of atmosphere in the room, the electrical output of the machine, the method by which it is applied, and the duration of the sitting.

The great electro motive force of this current gives it almost unlimited power of penetration, accumulation, and diffusion. When the machine is in action and we interrupt the continuity

of the output by a series of sparks anywhere upon the conductor, every particle of atmosphere in the room is thrown into vibration, and vibration is set up in the tissues of the patient. A person now seated upon the platform may feel with his extended hand the atmospheric commotion synchronous with the passage of each spark, and the person's hair, if sufficiently long, will exhibit the same oscillations to an observer. If we imagine every nerve fibre and blood-vessel in the electrified subject undergoing the same intense oscillatory stress, we can readily understand one aspect of its effect upon circulation and nutrition.

It was formerly the fashion to call in question the penetrating capacity of the static current and to claim that its action is limited to the surface of the patient's body. It is curious to see how such a contradiction became so deeply rooted in the literature of electro-therapeutics, for a very simple argument will prove the reverse.

This argument may take several forms, of which it is sufficient to present one, viz.: It is not claimed that galvanic and faradic currents pass only on the surface of the body between two applied electrodes. It has long been admitted that they both penetrate into the tissues beneath the skin. The resistance of the air, however, is so infinitely greater than that of the skin that neither galvanic nor faradic medical currents will pass between two conductors separated by an air space of an inch or any appreciable portion of an inch. Now, it is well known that the static discharge will pass through several inches of atmospheric resistance; and if a patient be seated upon a platform at the usual distance from a Holtz machine, but without any conducting attachment to it, he will be sufficiently electrified to yield a perceptible spark. I have frequently measured the distance at which the breeze from a point electrode can be felt, and found it to be upward of forty inches. Metallic bodies, thirty or more feet removed from an operating machine, are influenced.

After witnessing this exhibition of a power of overcoming resistance so enormously surpassing the power of either current which admittedly penetrates within the human body, the theory of surface limitation is difficult to maintain. A rifle bullet that will pierce steel armor will hardly be stopped by a wooden shingle.

Moreover, the original theory of surface action started from the physical laboratory and had no relation to action within human tissues.

When we consider the countless evidences of high potential, the spark, the excitation of a Crookes tube which neither the galvanic nor medical faradic battery will even glow, and the vigorous muscular contractions set up by the interrupted static current, we have only to wonder that the curious transposition of fact regarding its self-evident voltage was ever allowed to find its way into print.

Leyden-Jar Currents.—The physiological actions are along the same line as the actions of improved high-tension induction coils.

It is often stated that this form of static current is in fact superior to any coil. It is also sometimes stated that every application of faradic currents can be duplicated by Leyden-jar currents. In practice these opinions are not quite true.

Without taking into account any exact difference of maximum potential between coil currents and Leyden-jar currents (for the medical dosage will always be regulated to the case in hand), it is proper to say that a slowly interrupted current from either an improved coil apparatus or Leyden jars will do about the same therapeutic work. If a common faradic battery is in question it must be stated that the Leyden-jar current outclasses it entirely in every respect; but that is because the common faradic battery is an inferior appliance and should be no longer considered as a therapeutic instrument.

When we take into consideration a very rapid interruption of the current, then the finer coil apparatus (such as the au-

thor's) presents some qualities which the Leyden-jar currents lack.

Both rapid and slowly interrupted Leyden-jar currents are adequate for all therapeutic applications upon the surface of the body which relate to ordinary nerve and muscle effects. But if the physician will test the splendidly even and smooth action of the rapid vibrator current from my induction-coil apparatus by the bipolar electrode held in the hand, and by a telephone receiver held to the ear, and then make the same tests of the finest Leyden-jar current that can be obtained, he will discover that it is inferior for sedation effects upon inflammatory tissues and especially for employment within the pelvis. It is manifestly too rough and ragged, and is interspersed with secondary discharges, and an unevenness which is inseparable from the manner in which the static current is produced. It may be used within the pelvis in subinvolution with slow interruption, but I would not consider it suitable to gynecological practice with the bipolar electrode for sedative effects.

Leaving this branch of work aside, therefore, and considering external applications for the most part, it remains to say that the well-understood physiological actions of coil currents differ in no respect of importance from Leyden-jar currents.

When a slowly interrupted Leyden-jar current stimulates a motor nerve it causes a muscular contraction. This contraction will be more powerfully manifested at the negative electrode when both are of equal size.

The electrodes employed with Leyden-jar currents may be either bare metal or covered with sponge or felt, and do not differ from those employed with faradic currents. They are attached to the terminals of the machine by the usual conducting cords, and although a pair of extra long hard-rubber handles is usually furnished with the machine, they are a luxury rather than a necessity, for any handles, or no handles at all, will serve the purpose.

It must also be said that the single pair of sponges which

are the regulation equipment of every machine are but the most primitive beginning of a full equipment of assorted electrodes which the physician will require if he attempts to employ Leyden-jar currents for all the purposes of faradic currents.

If the plates of the machine are revolved very slowly, and periods of less than one hundred per minute are regulated in current strength to a therapeutic dose, the contractions of muscles set up by this means will alternate with relaxation and rest, and the nutrition and strength will improve. This is the way to restore the function of a partly paralyzed muscle.

If the plates are made to revolve faster so that the frequency of interruption will be several hundred per minute the muscles cannot relax and rest, and the current strength, which was comfortable before, will now be unendurable and quickly produce fatigue and pain, for the muscles will be overworked unless the current strength be reduced to tolerance.

If, however, the plates are made to revolve still faster so that the periods will be somewhat increased and the current strength reduced to tolerance by reducing the spark gap, an excellent gross-massage effect will be produced by passing the roller electrode over the surface of the body.

If the rate is doubled and the method of general faradization is employed, the same effect will be produced with the Leyden-jar current as with the induction coil, and if the periods are now made very fast and the current strength adjusted to produce a comfortable thrill over the surface and mild contractions over motor points, a general tonic administration will be made which will combine circulatory and vasomotor effects with nerve and muscle reaction.

The physiological effects of Leyden-jar currents are not varied in their specific nature by different individual properties of small, medium, or large jars. The academic discussion of Leyden-jar discharges, and whether they cause "painless" or "painful" muscular contractions, does not demand serious attention. I have never read anything on the subject which was not con-

fusing to the novice or filled with erroneous statements. Any physician can connect a pair of jars of any size and test different regulations of length of spark gap and rapidity of interruptions for himself, and five minutes of such information will be worth more than all the discussions that have so far been reported.

The fact is that the *maximum* capabilities of current condensation differ with the surface area of each size of jar, and a large jar has a greater capacity than a small jar; but as it fills up from the same electric source with exactly the same current and is never employed in medicine except with an exceedingly small fraction of its utmost capacity, it follows that any expert operator can regulate a desired dose so that no blindfolded person can tell what size the particular jars in circuit are.

When any Leyden-jar current is properly regulated to a medicinal dose and is interrupted with a maximum of rapidity, it is a high-potential, high-frequency current, and develops the physiological effects attributed to such currents. These are described fully in another chapter.

They unite upon nutrition the good effects of exercise, warmth, increased blood supply, and fine vibratory massage. They are circulatory, muscular, and nerve stimulant, tonic or sedative, according to the manipulation and dose.

The patient must disrobe sufficiently for the purposes of a given application, and moistened electrodes must be placed in direct contact with the skin. One or both of these electrodes may be held stationary or moved about, but as the methods are similar to faradic therapeutics I need not describe them, but will refer only to the action during the passage of the current.

It is possible to secure the following physiological effects from rapidly interrupted Leyden-jar currents: They contract blood-vessels as well as muscles, increase peristalsis in all non-striated muscular fibre, stimulate every part of the nerve, whether cell or fibre, excite nerves of special sense, quicken the

circulation and glandular secretion, combat blood stasis, relieve congestion, and promote the absorption of effusions and the eliminations of products of waste. The processes of oxidation are quickened, the elimination of urea, carbonic acid, and water is increased, and incomplete food combustion is more completely carried on.

When these rapid vibratory impulses are directed with the flow of the blood current they reinforce the vermicular movement of arteries and the functional activity of nerves. In the reversed direction they retard the normal current through blood-vessels and nerves.

These currents relieve pain in the same manner that induction-coil currents relieve pain; they are useful to every possessor of a static machine; but in practice they are very seldom employed. The portability and convenience of the smaller and eminently satisfactory high-tension induction-coil apparatus as shown in Fig. 2 gives it a certain superiority for practical work which the Leyden-jar current does not possess. The theoretical merits of the latter are not denied, and by any physician who possesses a good static machine and only a poor faradic battery the Leyden-jar currents should be preferred.

Owing to the fact that it would be a work of supererogation to repeat in this book the entire therapeutics and technique of faradic currents, I have deemed it sufficient to set forth the chief physiological actions and leave those who wish to employ Leyden-jar currents therapeutically to pursue the faradic methods with which they are already familiar.* There is no difference worth speaking of in the technique. There is, however, one other important reason why they are so seldom employed when their merits are admitted. To the man who possesses no static apparatus the coil current is the only alternative. But the physician who already has at hand the source from which

* Full descriptions of these operative methods are contained in the author's work upon "The Treatment of Disease by Electric Currents," a handbook of plain instructions in the uses of galvanic and faradic apparatus.

his Leyden-jar currents would be obtained if he desired to use them, has other applications available which dispense with the removal of clothing, and which not only do many things that the Leyden-jar currents cannot accomplish but include within

Fig. 2 Represents the Author's High-Tension Induction Apparatus. This improved therapeutic apparatus embodies the following features: An upright switch-board with posterior invisible compound induction coil, approximating 8,000 feet of 36, 32, and 21 wire coils, permanently fixed over the primary helix; the author's original secondary current controllers and primary rheostat; the author's method of dose measurement; an interior battery of six dry cells; also rapid and slow interrupters, pole reverser, adjustable magnetic field, switches, etc. A complete description of this apparatus, written by the author, was published in the *Times and Register*, August 25th, 1894, and an account of the method of dose measurement appeared in the New York *Medical Record*, December 21st, 1895.

their sphere of action almost the whole practical range of utility belonging to the more troublesome method.

I have made an attempt to explain this matter very clearly and at some length because there is some confusion on the subject, and physicians who read desultory references here and there do not obtain much helpful information to enlighten them.

Length of Seances.—In all electro-therapeutic applications of either galvanic, faradic, or static forms of current, the length of the sitting is always a factor in dosage. The physician will always ask himself what the proper length should be, but in the beginning of his experience he may puzzle over the answer.

The fact is that electrical effects are dependent on intensity of action, and the time limit must carry these effects to the desired point and then stop. Time and intensity are not convertible terms in the uses of either electricity or heat.

To illustrate: Take a hot oven that will bake biscuits properly in fifteen minutes. Call this unit of heat one, reduce it four times and multiply the time the biscuits are in the oven by four. One-fourth of sixty minutes is still fifteen minutes, but the result will not be a well-baked pan of biscuits. During their hour's sojourn in the lukewarm oven they would be simply dried and unfit to eat.

Now multiply the unit of heat by four and reduce the time limit in proportion and we would find that the great intensity of heat action now going on in the oven would not properly cook the biscuits in three and three-quarter minutes, but would burn them so they could not be eaten. These principles apply to the uses of electric currents in medicine and the exact regulation of intensity and time becomes instinctive with the trained operator, although it is exceedingly difficult to write directions for the explicit guidance of the beginner.

What is here said about heat effects relates most closely to the chemical polar action of galvanic currents applied with bare metal electrodes, but the idea conveyed is applicable in principle to all medical currents.

Stimulation is generally a quick process and the application short, for over-stimulation is not desired any more than exhaustive fatigue is indicated when we recommend beneficial exercise to a patient. Therefore the application of static electricity by special methods for the particular purpose of either local or general stimulation involves short sittings of a few moments.

Counter-irritating applications are regulated as to time by the same principle and are very short.

General tonic applications of static electricity involve slower-acting methods and take more time. Probably fifteen minutes is an average length of treatment for this purpose.

Sedation involves an opposite principle and still slower method when the condition attacked is extreme, and present relief must not only be obtained but more permanent effects aimed at.

Local circulatory sedation is often as quickly affected as local stimulation, but these remarks are directed to neurasthenic and hyperexcitable general states rather than local. Time in these cases must be extended beyond short *séances* and persisted in until effect is secured, whether it takes twenty minutes or half an hour.

In a doubtful case a few additional moments is a safe allowance, for we cannot over-soothe, over-rest, over-refresh and vitalize an exhausted nervous system.

In the treatment of every such case I compose the patient upon the platform in the most comfortable manner and enjoin the most silent and relaxed state of the nervous system. Sociable gossip is entirely out of place while such a patient is on the platform, for the nerve forces must be placed at rest and in harmonious action with the current to obtain the best results. Recumbent rest for a time after treatment is also advisable. Management of these cases is as important as direct current action.

While some of the effects of static electricity are quickly and with wonderful facility obtained, yet it must be borne in mind that chronic and obstinate cases fall to the lot of the electro-therapeutist, and what is said in this book about the results of treatment can be accepted as true only upon the basis of intelligent, persistent, and often very hard work to obtain them.

In 1777 Robert Steavenson published a brief treatise in

Latin upon the subject of static electricity which contained this short extract of clinical wisdom:

Before we bring this part of the dissertation to a close, it must be observed that doctors seldom persevere in the use of electricity with sufficient diligence, for we ought not to forget that though electricity removes some diseases all at once, and as if by magic, still in others it must be used with long patience; and though the patient may have received no benefit from it after two or three months' use, still success is by no means to be despaired of, for it has removed, even after six months, diseases which could not be cured otherwise. But Shenstone says, "*Patience is a panacea; but where is it to be found and who can swallow it?*"

No physician who employs static electricity should attempt to deal with difficult and chronic cases in short *séances*. The times given throughout this book will be a fair average for the expert with a powerful static machine and the machine at its maximum of power.

If the machine is not cared for and operated so as to represent this degree of efficiency, longer sittings will be required to secure the same results. Skill has the twofold value of economizing time and securing good clinical effects.

CHAPTER XIII.

THE THERAPEUTICS OF STATIC ELECTRICITY.

Operative conditions required for success. Indications for static electricity in general. Its uses in the surgeon's office. Its practical utility in the treatment of general diseases. Limitations which regulate its actual use. Disrobing for general electrical applications. The value of the static machine in office practice. An illustrative case. Relief of minor ailments during chronic treatment. Clinical remarks.

In all that is said by the author in these pages, both as regards technique and results, to be reasonably expected from static electricity, it is presupposed that all proper operative conditions are fulfilled.

The static machine must necessarily be of the large therapeutic size, must be kept in maximum working order (dry and clean); the room must conform to the requirements of this high-potential and variable current, and the operator himself must perform his part.

No fine mechanical apparatus does its best work when new. A steamship, an engine, a typewriter, a motor, a fine watch, and a static machine all require an adjustment, regulation, and "breaking in." Having possessed at various times each of the three modern types of large static machines, and having passed through dog-days with them all, I am obliged to say that no machine I have ever operated has done its best work as it came new from the maker's hands. Having, however, learned by experience the idiosyncrasies of each apparatus, and offset them by the resources of operative ingenuity, I have succeeded in procuring a powerful and abundant generation of current without any further interruption worth speaking of.

I attribute justly a large measure of my uniform ability to

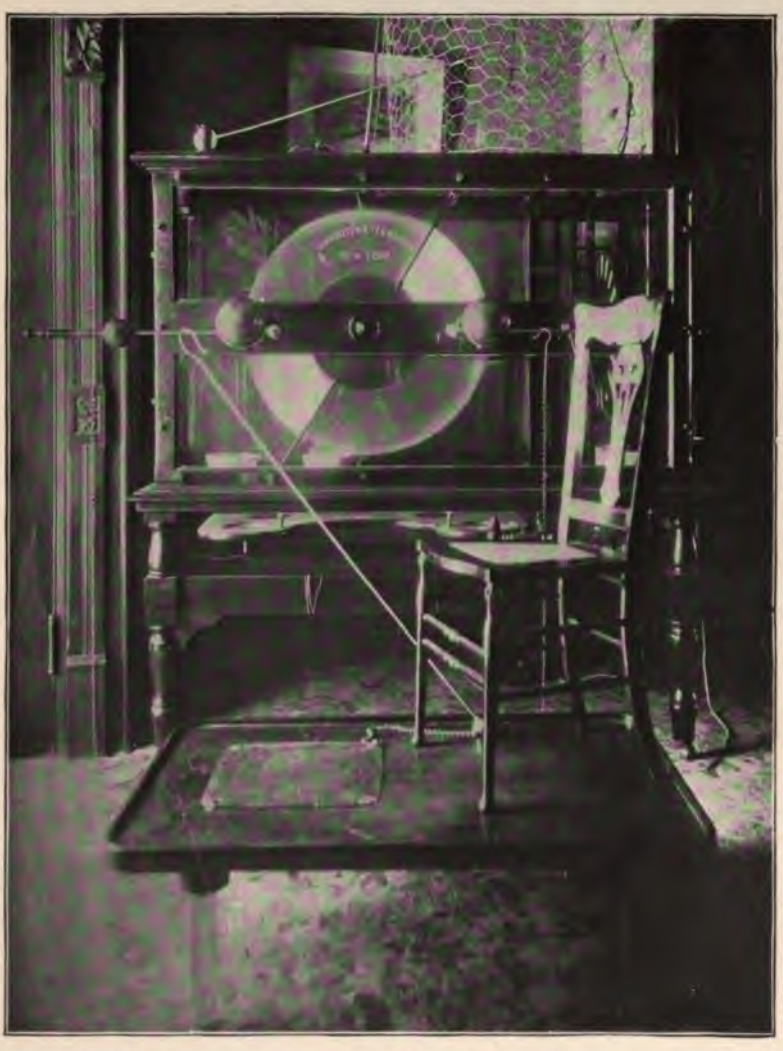
obtain a working current on every day in the year, even though located in a rather damp climate near the ocean, to the fact that I have not trusted the machine to chance and a workman's adjustment, but have personally revised it to the maximum point of efficiency, and thereafter constantly given it the equivalent of care that would be given a good horse by a man who expected it to do regular work. Neglect never develops high efficiency.

It is also assumed throughout these pages that good conduction is maintained between the apparatus and the patient, that the current is not wastefully leaked away from the prime conductors, that the groundings are correctly made, and that all electrodes, the platform, chains, etc., are as they should be. A good current may be cut down one-half by a bad platform alone, even if there is no leakage from the prime conductor, and it may be mentioned in passing that of four platforms purchased by the writer in different years but one was entirely satisfactory in clinical use. A platform may fail in either of two ways: by poor insulation or by bad conduction.

The master of all that pertains to the satisfactory operation of the splendid modern Holtz machine has very little trouble with it; the tyro is in trouble continually. The obvious remedy lies in obtaining the requisite instruction in operative management before attempting to treat patients.

Indications.—The theoretical range of therapeutic indications for static electricity is nearly as wide as disease itself, for at some time in almost every important deviation from health it can be employed with benefit to the patient, if the physician and patient so desire. It may be usefully prophylactic before lessened tissue resistance furnishes the nidus for definite disease; it may in some form palliate, and in other cases cure, a great many states of sickness which are not toxic or febrile; and when no active part befalls it in acute stages it will do much to shorten a tedious convalescence.

In the surgical office it will light up a Crookes tube more



Author's Static Apparatus. Showing foot-plate on platform with chain to rod connected with one prime conductor. Opposite prime conductor grounded. Machine adjusted for simple electrification. Upon the top of the case is partly seen the static cage which is lowered over the platform for use.

radiantly than any other present means of electrical excitation, and with the fluoroscope or photographic plate make the examination of fractures, dislocations, and a variety of bone lesions more satisfactory and instantaneously than any other means.

It will often relieve the nerve and muscular effects of traumatism, allay local inflammations, subdue pain, restore the circulation to contused parts, quicken the reparative processes of nature, increase mobility of stiffened muscles and joints, provide a superb form of passive motion and massage, excite recuperating contractions in muscles paralyzed from injury or the inaction of splints, tone up and strengthen the patient, and in expert hands will render with quick facility and with far less trouble than any other equally efficient procedure an immense amount of invaluable aid.

It is the most extensively useful single instrument now employed in medical office practice for the relief of non-operative and non-septic conditions, and is absolutely without a therapeutic rival in the complex and useful nature of its achievements.

It may be granted at the outset that certain conditions of disease and certain pathological states will never, or very rarely, enter into the consideration of static electro-therapeutics, so long as its employment is inseparable from the physician's office. Acute infectious fevers and contagious diseases are examples. Such affections as in an acute stage are rendered worse by exposure to outdoor air are of course other examples, and also cases in which neither of these conditions operate, but which are accompanied by symptoms which render recumbency and rest essential.

Thus by a simple elimination of classes of cases, such as will occur to the mind of every experienced practitioner, including conditions in which the result of time-tried remedies leaves little or nothing further to be desired, we define the limitations which practically determine the uses of static electricity.

We therefore find its chief field of usefulness in the treat-

ment of conditions, either acute or chronic, which have to do with nerve action, circulation, muscles and joints, pain, functional processes and nutrition.

From the standpoint of pathology its tissue action is very narrow, but so is that of iron; but both iron and static electricity become of immense practical usefulness from the commonplace fact that a great many people present the conditions which they favorably affect. Phosphorus cuts a much wider swath through the human tissues in its physiological action than does iron, but fifty patients need ferrum where one needs phosphorus.

Yet, operating within the boundary of its proper restricting limitations, it will be observed that the same static machine will accomplish much more in some hands than in others. There are in every department of mechanics certain workmen who have the knack of getting exceptional work out of ordinary tools. I have seen watchmakers with an elaborate outfit of costly implements whose skill in using them was much less than their cost, and I have seen others with but a few plain tools who would handle successfully any job on the workbench.

This difference in the native knack of men will always influence both the variety of work done by the static machine and the satisfaction with which it is utilized in individual practice, for it cannot be too strongly impressed upon the mind that it is the presiding genius and personal ability of the operator, and not the intrinsic resources of the machine, however great, on which rests the successful application of static electricity. This is the explanation of many of the failures and disappointments recorded against the static machine of some years ago, and it is equally in force to-day.

Disrobing for General Electrical Applications.—A careful study of the causes which operate to render general electrical applications distasteful to patients, and repugnant to physicians in ordinary office practice, places disrobing in the front rank and leads me to emphasize here an advantage possessed by

static electricity which is of surpassing and even incalculable importance in practical electro-therapeutics: *it requires no removal of clothing.*

Minor or limited local applications of galvanic and faradic currents may readily be accommodated to the necessity of surface-contact electrodes, for exposure of the person can either be avoided or restricted in extent. But both physician and patient may well stand aghast at the mere thought of general administrations of any form of electricity which involve both the drawbacks of disrobing in an office and the application of the hand or moist electrodes to the entire person. These drawbacks, relating both to the disrobing and to the treatment, cannot be appreciated at their full weight without experience with cases suffering from pain, deformities, paralytic affections; or fashionably attired women; or persons whose failing faculties, crippled conditions of limbs, or sensitiveness to the appearance of undergarments make it difficult, embarrassing, or practically impossible for them to undress and dress themselves again in an office.

To the therapeutist who recognizes the usefulness of general electrization in a large proportion of all cases in which electricity is indicated at all, it is simply despair to contemplate galvanic and faradic methods for constitutional, tonic, and nutritional effects.

The usual alternative in practice is to disregard them and wholly ignore the benefits they would produce. This alternative does not confront the possessor of a Holtz machine, and the facility with which an expert can by its aid employ the resources of general electrization without any of the loss of time and inconvenience of disrobing, puts the stamp of practical superiority upon a form of current whose properties are peculiarly adapted to general administrations for sedative, tonic, alterative, restorative, and nutritional effects.

A considerable clinical experience convinces me that I can treat ninety per cent of cases amenable to benefits from any

form of general electrization more successfully, quickly, and with more permanent satisfaction by the aid of the static machine than by currents requiring the application of electrodes to the body.

Granted an equal therapeutic value, the current which may be applied through the entire clothing possesses an advantage over all others. It is this advantage which belongs to the static machine and which places it prominently among the necessities of a complete electro-therapeutic equipment for general medical and surgical practice. The indispensability of both galvanic and faradic apparatus has long ceased to be open to question, and when the technique of the third great therapeutic instrument is once mastered, it will be found equally indispensable.

The Utility of the Static Machine in General Practice.—In an article upon the nutritional effects of vibratory electrical administrations by the author's method, published in January, 1896, I remarked that I valued the medical services of electricity far more for its utility in a thousand practical every-day cases than for its power to slightly benefit an advanced stage of some rare and incurable lesion of the central nervous system.

An example of the practical value then referred to will illustrate electro-therapeutic resources available to every physician and surgeon.

Mrs. ——, aged 72, weight two hundred and forty pounds, twenty years ago fell and fractured the left patella; later broke it a second time, with resulting non-union, and the fragments are now separated by one-half inch. She walks unsteadily with a cane and frequently falls. She always fears that her leg will give way under her. Has pains in the limb and severe coccygodynia from one of her falls, when she struck forcibly on the coccyx some years ago.

She has had for the past month an intense facial neuralgia of the right side; is unable to eat solid food, and scarcely able to open her mouth to take liquid nourishment, as the pain is worse from movement of the facial muscles. From loss of sleep and nourishment she reports herself "discouraged." It

was for the neuralgia only that she came to me for treatment. She had "tried medicine" without relief and had been advised to "try electricity."

Her unwieldy weight, great age, irritable state, and impatient disposition from extreme suffering made the removal of her complicated winter garments out of the question. Accordingly, while the facial neuralgia might be relieved by a galvanic or coil current, the treatment of the spinal and leg pains and muscular debility could not be undertaken with locally applied electrodes; nor did the patient expect to be treated for these conditions as she regarded them as incurable.

My method was much simpler than local faradization and far more comprehensive. Without even untying the strings of her bonnet or removing her winter cloak, I seated her upon the static platform and connected it with the negative pole. The positive pole and brass point electrode were then grounded to the gas fixture. A sedative spray was applied to the facial nerve-distribution from the ear to the mouth, holding the electrode just far enough from the face to avoid a spark (about two inches).

The spray was moved gently over the seat of pain until relief was complete. The same electrode was then shifted to the spine, and anodyne counter-irritation applied by sweeping the point up and down the painful parts just near enough to scatter fine spray discharges, interspersed with minute needle-like sparks. When this region was relieved, a few thick positive sparks were then applied to the lumbar and sacral region, and to the muscles of both the injured and other limbs, to increase their tonicity and thus compensate in some degree for the impaired leverage of the patella and lack of exercise.

Duration of *séance*, eight minutes. Time required for preparation of Mrs. ——, both before and after treatment, and getting ready for the next patient, was less than one minute, for it consisted merely of getting her on and off the platform and starting and stopping the machine.

Sittings were repeated three times a week in this case, although daily treatment at first would have been better. At the fifth visit she reported that she could eat bread comfortably and that her back and legs felt no more pain. At the sixth visit she wanted to know if she needed to come any more, as she "felt so well." After the seventh treatment she was discharged, with entire relief from all pain and considerable increase of muscular energy. Several weeks later she sent a grateful message that the benefits had continued.

The points of interest in this case relate to the improvement in walking obtained by strengthening the general leg muscles without regard to surgery for the patella, which she said she was too old to consider; the relief of pains in both back and lower extremity without the removal of any garment; the relief of the facial neuralgia; the immediate consequent improvement in sleep and nutrition, and the transformation of an irascible invalid into a comfortable and genial old lady.

A therapeutic apparatus capable of such services in short sittings of about ten minutes, with a minimum of trouble and no exposure of the person, demonstrates its practical value in a physician's or surgeon's office.

Moreover, many of the over-refinements of faradic and galvanic technique described by former authors to secure particular nerve and muscle effects are unfamiliar procedures to the general practitioner. He cannot remember them when he wants to apply them. If he has a static machine and knows how to use it, he need never regret their unfamiliarity in such cases as I have above described.

Relief of Minor Ailments During Chronic Treatment.— The value of the knowledge of how to relieve many of the minor but annoying symptoms of disease by some form of electrical application does not of course depend upon the demand for such relief by patients not already under treatment for more serious conditions. Very few practitioners and certainly few of the laity are aware of half that electricity will do to relieve or entirely remove a large number of small troubles that flourish in chronic diseases. The electro-therapeutist will not expect that patients will come to him instead of the family physician to be relieved of small aches and pains; but when the physician in either general or special practice commands the entire resources of galvanic, faradic, and static therapeutics, and is treating the more serious conditions which bring his patients to him, it is of inestimable value and a source of great comfort to be able to ward off so many of the minor acute

or chronic grumblings of the system that distress the patient and often delay the case. Relief can frequently be given with little or no extra time or trouble during the course of the major static application, and it is for this reason that directions for combating a number of trifling ailments are included in this book. With this fact properly understood, the apparently "cure-all" nosology of leading treatises on electro-therapeutics would disarm the sceptic's smile and obviate much of the criticism that has long been directed against an agent of such complex properties as electricity. The fact that this agent can be caused to do more therapeutic work within the tissues than can drugs of single or simpler action sometimes appears unreasonable to medical minds familiar only with drugs and unacquainted with electro-physiology.

Without dispute a simple prescription would also relieve some of the symptoms above referred to, but it is not less to the credit of electricity that it is able to afford the relief without the prescription. The theoretical mind may not discriminate between the two methods, but in general practice the advantages derivable from the complex and varied potentiality of the static current constitutes as great a benefit to the patient as does its efficacy in some of the incurable diseases for which electricity is usually recommended after other remedies have altogether failed.

Clinical Remarks.—In any protracted course of treatment the best effects are secured, not by adherence to a routine, however particularly indicated it may be, but by occasional changes of current and method. Constitutional electrization may nearly always be beneficially engrafted upon local measures, and for this purpose a well-handled static machine works in harmonious alternation with the galvanic and faradic currents. Nature, in health or disease, often revolts at monotony.

CHAPTER XIV.

RHEUMATIC DISEASES.

Lumbago, torticollis, cervicodynia, pleurodynia, and all forms of muscular rheumatism and muscle pains, acute, subacute, or chronic. Method of treatment. Muscular rheumatism and general neuralgic state—a clinical case. Obstinate chronic lumbago and similar conditions, so-called. Articular rheumatism, subacute and chronic. Indications and methods of static treatment. Obstinate and unyielding articular rheumatism. Methods of treatment. Swollen and painful joints without acute inflammation. Rheumatic stiffness and partial paralysis. Sore and tender bony prominences. Rheumatic headaches. Rheumatic derangements of circulation and animal heat. Obstinate lingering pains. Posturing during treatment. Remarks on medication and the duration and frequency of the electrical part of the treatment of rheumatism. Prognosis. Flatfoot. Rheumatism among workers in electric light and power stations. Effects of high- potential and high-frequency currents in rheumatism and malnutrition. Report by Apostoli. Gonorrhœal rheumatism. Rheumatoid arthritis. Medical remedies. Electrical treatment in full. Prognosis.

Lumbago, Torticollis, Cervicodynia, Pleurodynia, and all Forms of Muscular Rheumatism and Muscle Pains, Acute, Subacute, or Chronic.—Seat the patient, fully clothed, upon the insulating platform of the static machine, and connect it with the negative pole.

Ground the positive pole, together with the brass point electrode, to the gas fixture.

Start the machine into moderate action and apply a concentrated positive breeze to the painful part. Gradually sweep the point nearer the surface so that a succession of spray showers will be thrown upon the muscle.

In a moment increase the intensity of the application so that fine needle sparks mingle with the spray. Have the patient attempt such movements and postures as are most difficult to

make and which aggravate the pain. The effect of this positive spray will immediately be warming, sedative, relaxing, and anodyne to the stiffened and sore muscles. In very recent and simple cases such a counter-irritant spray will produce entire relief in from three to ten minutes.

If the case is of a little longer standing slow down the machine, which has gained quite a rapid rate during the spray administration, and apply a sufficient number of positive sparks from the grounded brass ball electrode to complete the relief.

Begin with a very mild spark and increase the vigor gradually until results are secured. Avoid bony prominences about the joints. Apply single, thick, clean sparks directly to site of pains and over adjacent muscles. Apply a few at a time and note the relief afforded. Continue to posture the patient so that every possible aggravation of the pain is caused and in each position apply the sparks until relieved.

Persist until the patient steps from the platform free from pain and walks and moves about with perfect comfort. Never let a case of myalgia get off the platform while any pain is left.

If the case is more chronic and deep seated and has resisted a good deal of treatment in other hands, proceed at once to vigorous counter-irritation and strong sparks, with the platform connected to the positive pole and the negative grounded. With the brass point electrode throw repeated showers of hot spray upon the stubborn muscles and finish the attack with strong, sharp sparks.

If the lumbar region or an arm is affected, or any part over which the brass ball electrode can be rapidly rubbed a few times to set up an intense stimulation by friction, do this for a moment at the end.

Time required in any case will rarely exceed ten minutes. Repeat sittings daily at first in acute or severe cases. In others, or after partial relief, repeat every second day, or three times a week.

Complete and permanent effects will vary, with the nature of the case, from one to four treatments in mild recent cases to perhaps a month in some that are very chronic.

If static electricity is properly applied to muscular rheumatism and fails to produce satisfactory results, the patient has *some other affection and not* muscular rheumatism. There is nothing more certain in therapeutics than the absolute relief to all forms of muscular rheumatism afforded by electrical currents, and the simplest and most effective current to apply is usually the static.

When we consider other internal and external methods of treatment differently advised in almost every text-book on general medicine, and the uncertain results which many patients obtain from common practice, including hypodermics of morphine, plasters, and liniments, the positive value of static electricity in myalgia cannot be overstated. An eloquent author of "A Practice of Medicine" (1892) devotes a dozen lines of warning against the use of opium in this affection, but his sole reference to the one remedy which is wellnigh an unfailing specific is as follows: "Electricity also has reputation for the cure of these cases, but I have never had occasion to use it."

Muscular Rheumatism and General Neuralgic State.—Miss ——, aged 27 years, five years ago had an acute attack of rheumatism affecting in turn ankle, knee, shoulder, and heart. Her doctor told her that she had "neuralgia of the heart." She has had a continuous career of invalidism for the past five years. Had some uterine condition the nature of which is not now known to her, but after eighteen months of unavailing local treatment her ovaries were removed two years ago, and since that time she has wellnigh impoverished her family by "doctors' bills."

Since September last she has not had two weeks' freedom from alternating attacks of severe muscular rheumatism of all the muscles around the neck, shoulders, and chest, and what she called a sore throat. Sleepless with pain, worn out, and wellnigh utterly discouraged, she has had also to contend with neurotic disturbances that add to the intense agony of the rheumatism and neuralgias.

Liniments, lotions, and the best medical treatment she could obtain during the past five years have failed to improve her condition. Having heard that electricity might give her relief she gathered together her shattered strength and succeeded in getting to my office. She could just keep on her feet. Her head was drawn downward and to the right side, the muscles felt hard and rigid, those of the chest felt so constricted that she was unable to breathe deeply; her throat was swollen, she felt "sore all over," she had sciatic pains in the left leg; her thighs hurt her so much that she could not press them together; she felt intensely cold around the pelvis, quivered under the slightest draught, and was in an extremely pitiful condition. Her neck was swathed in absorbent cotton. She had on a winter cape with a high collar for protection from the cold, and a hat secured on her head with a veil. Her muscular agony was such that she was unable to remove either the cape or hat, and leaving them on she stepped to the static platform. This was on the 8th of March, 1897.

I applied, after a few moments of simple positive electrification, a hot negative spray to the spine, sides of the neck, and upper chest. Pretty soon the head began to straighten up, in three minutes she could take a deep breath, and after a hard-fought battle of twenty minutes she stepped from the platform with a sense of warmth and comfort all over. She had not a pain or symptom left anywhere. This was at 2:30 P.M. She left the office with her head erect and happy; she went home and remained comfortable the rest of the day, and enjoyed a good night's sleep. According to instructions she came again the next morning. Her condition had relapsed in only a small degree. The head was not drawn to one side nor were any of the muscles extremely painful. A second treatment was given with entire relief, and on the next day the third treatment was given.

The transformation wrought by these three sittings of static electricity would have convinced the worst sceptic that it was worth all the other agents in the materia medica for the relief of the worst type of muscular rheumatism if the aforesaid sceptic had witnessed the administration. It is seldom, however, that the neurologist or specialist in any other branch of medicine, who takes it upon himself to brush the facts of clinical experience aside, ever gets near enough to a static machine in

action to see it work, and as a matter of fact bases his statements on prejudice alone.

It will be possible to do a great deal to relieve the neurotic condition of this young woman by the simple aid of static electricity, after her five years' failure to attain health through the attentions of the gynecologist, the ovariotomist, and skilful medical prescribers. Regular treatment for a few months will help her greatly.

Case reported by Dr. W. C. Allen, Cranford, N. J.

Mrs. G——, a lady suffering from acute muscular rheumatism of the right deltoid and trapezius, which had continued about ten days and in the last few days showed signs of affecting the chest and back muscles, was given only one treatment with the positive pole attached to the spray electrode, and the current centred over the affected muscles. She went home that afternoon somewhat relieved, and when she awoke the next morning there was no pain, only a slight stiffness, and that soon left and did not return, and since then she has had many colds, and once an attack of rheumatism in the hip, which I cured in the same way, but there has not been the least sign of a return of the trouble in the shoulder.

Obstinate Chronic Lumbago and Similar Conditions, So Called.—The static spark is very certain to cure all these states that are confined to muscles, but its sphere of action does not extend so well to pains deep in the spinal articulations. It often happens that some final pain resists the breeze and spark in a case of chronic lumbago. When this is observed, and is evidently a joint and not a muscular affection, place the small Leyden jars in circuit and a large sponge or felt-covered electrode both upon the abdomen and over the rheumatic vertebræ. Make the posterior electrode positive, short-circuit the sliding poles of the machine, start the plates into rapid action, and draw the poles just sufficiently apart to produce agreeable sedation.

As relief advances, increase the current strength moderately. Length of sitting, fifteen minutes or until effect is complete. Repeat daily a few times, and thereafter as may be needed.

Articular Rheumatism.—The different manifestations of rheumatism require some adaptation of the electrical method to the patient.

In the general rheumatic diathesis, with shifting pains and irregular symptoms at different times, the static part of the treatment aims at both local relief and at general alterative and nutritional effects. As ordinarily employed it cannot stand alone in the satisfactory treatment of patients whose rheumatism is general and subject to inflammatory relapses. The best results are obtained by assisting the action of electricity with diet and medication, and making the applications daily.

Apply positive electrification in its most efficient form for at least fifteen minutes daily. Add to this such localized breeze or spark applications as local symptoms may require, and as soon as the patient is accustomed to energetic treatment spark the spine and general surface with alterative positive sparks.

In all the varieties and stages of rheumatism, when any kind of medicine is known to do any good continue its use, for electricity interferes with nothing else and supports the remedy. Electricity also gives great relief to symptoms and renders valuable aid in overcoming the diathesis, but in subacute and chronic inflammatory articular rheumatism it must be pushed for effects and employed with discretion and not administered indifferently three times a week.

This is the least satisfactory kind of rheumatism to treat with static electricity. Do not apply sparks to any part within which a slumbering inflammation might be lighted up. The anodyne relief in such a state should be obtained from the breeze and sedative spray and in some cases frictions.

Obstinate and Unyielding Articular Rheumatism.—Cases of rheumatism of a well-known type sometimes persist in spite of all treatment. The patient has perhaps been through some years of experience with medication, proprietary cures, baths, possibly massage, probably galvanic and faradic methods, and finally lands upon the static platform with the rheumatism as

hearty and vigorous as ever, and the patient renewing hope for the tenth or twentieth time.

Treatment is pursued by the usual methods about three times a week, with immediate and grateful improvement. The headaches disappear, the muscular stiffness relaxes, sleep improves. In a couple of months or less the patient has very little further trouble "except in one place." If she "could get rid of that she would be all right."

Each application of ordinary sparks gives some relief and the general improvement has been very good, but finally, having no other pains to divert the attention, the patient concentrates her mind upon the single joint that is left to annoy her and she suddenly has a relapse. The routine treatment three times a week now seems as much of a failure as it previously seemed a success. The patient goes home with a few hours of relief before her and two days of suffering ere she comes again. The rheumatism seems resolved to die in the last ditch before it will surrender to static electricity or any other remedy, and these are the cases in which medicine seems utterly useless except for anodyne purposes. The disease localizes itself and intrenches in some impregnable Gibraltar around the hip-joint, for example, and surrounded by the unyielding fascia lata refuses to be driven out.

What then is the operator to do? Has static electricity failed? *Not always!* It has failed in the manner in which it was applied, but it has ammunition left and fresh reserves. About this time the patient is likely to say that she is pretty near discouraged and would do anything and submit to anything to get rid of the rheumatism. When this is the case the battle is half won.

Arrange with the patient to give you a better chance, to follow up the assaults which have given temporary relief until they hammer their way to the very gates of the citadel and compel an unconditional surrender. Arrange with him, or her, to come *twice a day* for treatment. Connect the platform with

the positive pole. Ground the negative pole and the brass point electrode to the gas fixture. With the machine in rapid action and a gentle use of the hot negative spray (made hot by having the patient wear suitable woollen garments) produce a preparatory warming up of the whole system. Then begin the genuine battle with the joint. Assault it by every device of stimulation, counter-irritation, and muscular contraction that can storm the tissues and conquer the disease.

First, with the brass point electrode and the patient postured in the most uncomfortable position in which the joint can be placed, increase the intensity of the spray around all the thigh, spine, and abdomen, and throw down shower after shower of stinging sparks as the point is swept over and across the tissues.

This is light artillery. Now bring up the heavy guns. The patient says she will "stand anything" if it will only do her good, and the sting of the spark is only for an instant, and these cases prefer it vastly to the continuous rheumatism. Exchange the point for the large brass ball electrode. Increase the current to its maximum energy. Pose the patient in different positions that will set up pain. Have her stand in a partly crouching position to make every muscle tense. At other times flex the limb with the foot upon a stool. Resort to every manœuvre that can develop pain, and in every position rain down upon the obdurate tissues such a storm of grape and canister that there is no alternative but capitulation.

Diversify the heavy sparks with intercurrent frictions over the site of the intrenched disease; allow the patient breathing spells of rest so that no real suffering will be caused by the application, and when she steps from the platform after about fifteen minutes' experience with the maximum capabilities of a well-handled static machine she will declare that she feels like a perfectly well woman. She will sleep soundly and restfully at night and will not only maintain a large part of the benefits of each treatment, but by these frequent and relentless repetitions will achieve as nearly a complete cure as it is possible for any-

thing on this earth to cure obstinate chronic articular rheumatism.

One, two, or four weeks of such treatment as I have here described will accomplish more than six months or a lifetime of routine puttering.

The operator, however, who undertakes such an energetic plan must have his patient in the proper frame of mind and must know precisely what to do and how to do it, for otherwise few patients would accept administrations of such apparent ferocity, although in the hands of a master of technique the treatment is perfectly tolerable and is not seldom interspersed with expressions of satisfaction on the part of the patient.

Leyden-Jar Current.—Still another reserved method which was first used by me four years ago embodies the physiological actions attributed to sinusoidal, alternating, high-potential currents and described in another section of this book.

Take any ordinary foot-tub and put in it a teaspoonful of sodium bicarbonate, a flat felt-covered electrode about ten inches square, and six inches of warm water. Place the medium or small Leyden jars in position for use. Carry an ordinary conducting cord between the negative jar and the terminal of the electrode in the foot-tub. Take also two glass jars or bowls in which the hands can be immersed above the wrist and fill them two-thirds full with the same solution as the foot-tub. Connect them with a bifurcated cord to the positive Leyden jar, which is of course the one connected with the negative prime conductor of the machine.

The patient sits in an ordinary chair with the bare feet in the tub and a wrap of some kind over them to protect from draughts. One of the jars is placed at each side and the hands are immersed. This gives three water-bath electrodes, which furnish a contact that cannot be surpassed or even equalled in any other way.

Short-circuit the sliding poles of the machine. Start the plates into very rapid action, and gradually draw the poles apart

until the patient experiences a comfortable thrill in either the hands or the feet.

Having regulated the current strength to comfortable tolerance, the application may be continued fifteen or twenty minutes.

It subjects the entire muscular and circulatory system to a fine vibratory massage. As this practically includes everything in the body but the bones, it exercises a marked effect upon nutrition, metabolism, and elimination, as set forth by Apostoli.

The method is applicable to gout, rheumatism, uric-acid and all other states in which general nutritional and alterative action is desired. This action is along the lines of a gradual improvement of the patient's condition and has the advantage over sparks that it causes little or no sensory effect. It, however, does not relieve local pain immediately as does the spark or breeze, and these may both be employed for symptomatic relief during the early stages of treatment by the Leyden-jar method.

This plan of treating rheumatism accommodates itself especially well to cases of an inflammatory character, and when the condition is general throughout the body instead of presenting a constant localization. It may be expected to give satisfactory results, or at least develop a very encouraging improvement, in about twenty daily treatments. If the case is so obstinate that it has resisted other measures, and if this plan affords reasonable encouragement, it should be persisted in one, two, or even three months, for those who have spent years in battling with chronic articular rheumatism should not refuse a small modicum of patience and perseverance to any remedy that is helping them.

Case reported by Dr. Franklin H. Clark, Cleveland, Ohio.

Mrs. H——, married, aged 40, three years ago was attacked with acute articular rheumatism affecting both knees, confining her to bed for two years; also had frequent attacks of lumbago.

During this time all the remedies in drug kind were tried with very little benefit.

After forty applications of the static sparks (these treatments were made daily) the patient could walk fairly well and at the end of three months was discharged cured.

Case reported by Dr. W. S. Watson, Fishkill, N. Y.

Mrs. W——, aged 37, had had a severe attack of rheumatic arthritis with resulting contracture of left leg, leg flexed to an angle of at least thirty degrees, firmly ankylosed, and of some four months' standing. The joint had been treated by massage thoroughly without any apparent relaxation or benefit. The case was treated by applying the Leyden-jar current, using one sponge under the foot of the affected side, and the other sponge about the joint for five or seven minutes, followed by the long spark from the ball electrode to the contracted ligaments and about the patella.

Fourteen treatments were given, one every third day, when the woman had so completely recovered the use of the limb as to go about freely without the assistance of cane or crutch and was entirely well, notwithstanding that when she came for treatment she was unable to get her foot from the floor.

Swollen and Painful Joints without Acute Inflammation.—To general positive electrification as before, add positive sparks to the knee, elbow, ankle, shoulder, or any other affected part. Begin cautiously, and if no aggravation is caused make the sparks of gradually increasing strength until they reduce the swelling, remove the pain, lessen stiffness, and finally restore all of mobility and strength that appears to be attainable. In these cases, as in all others in which the resources of electric currents are far superior to routine external applications for reflex effects, use no liniments, blisters, tincture of iodine, ichthyol, or any other local, superfluous, or useless application.

In these chronic joint cases static is more effective than galvanic or faradic electricity, and is vastly quicker and easier to apply. The results soon teach patients instinctively to prefer it after a few experiences with "family batteries" and home treatment.

Repeat the sittings as often as necessary to promote the best obtainable state of relief. If pain is severe and the relief from one treatment does not at first last even from one day to another, sittings should certainly be daily, or even twice a day, until the relief lasts longer. It is useless to try to "cure" rheumatism with any remedy that delays its second dose long after the action of the first has ceased. My experience leads me to infer that many failures permanently to improve articular rheumatism with electricity are the results of too extended intervals between "doses."

Rheumatic Stiffness and Partial Paralysis.—To the usual tonic electrification with the positive pole with which each treatment is generally begun add a suitably vigorous application of positive sparks until the stiffened muscles relax and their nutrition and functions are restored.

At each sitting entire relief from any present pain should be secured, with progressive improvement in mobility.

Posture the patient with the ankylosed joint under extreme muscular tension, and if it is the ankle, knee, or hip, have him stand with the entire weight of the body exerted in unison with the sparks. By this method the greatest possible mobility will be obtained. If an arm is affected, exercise the muscles near the joint with slow contractions by a slowly interrupted Leyden-jar current, or by winding the chain around the forearm and arm in succession, connecting it to the positive pole while the negative is grounded, and exercising the arm vigorously by the author's method of sparking the prime conductor.

Apply the sparks slowly for several minutes with intervals of rest to avoid fatigue. The sense of lightness, buoyancy, endurance, and general well-being imparted to heavy, stiff, and inactive limbs by this method is far more appreciable to the patient than the results of any other form of treatment known to medicine.

To establish improvement—which may at first appear to be very rapid and later very slow—the early sittings should be

near together, but can be lengthened to every second or third day as gains permit.

Sore and Tender Bony Prominences.—In the treatment of rheumatic cases with sparks we not infrequently find that some small area of prominent bone at the knee, ankle, hip, elbow, or shoulder joint, or some of the knuckles of the fingers, will be very sore and tender to touch.

The spark is not suited to parts which are not covered with muscular fibres, and is contraindicated. Some physicians have used the spark and complained that it aggravated rather than relieved. So will twenty grains of quinine aggravate a congestive headache to which it is not suited. The proper thing to do is to apply the right remedy, which is the positive static breeze.

During the sitting, with the patient connected with the negative pole, ground the brass point electrode, and have the patient bend the joint so as to expose most sharply the seat of tenderness. Then concentrate upon the part a very vigorous sedative spray, with the plates revolved rapidly, and the electrode swayed gently over the surface, just near enough to make the brush discharge luminous. A couple of minutes is usually a sufficient time. Repeat at each sitting during the course of treatment until sufficiently improved.

Rheumatic Headaches.—I usually devote a couple of moments' attention to a head breeze during the general treatment of rheumatic patients who report habitual headaches. If the headache is present at the time of treatment I continue the application longer until it is entirely relieved, but as a rule nutritional improvement soon takes care of this symptom without any special head treatment at all.

The relief from head pains, which often appears marked by the end of the first week of treatment, is one of the reasons why patients who have long taken medicine in vain appreciate the practical merits of static electricity.

Rheumatic Derangements of Circulation and Animal

Heat.—Some of these cases have habitual cold hands and feet which do not readily warm up in bed at night even with a hot-water bag against them. If the extremities are still cold after the preceding applications I close the sitting with a few very mild and clear-cut positive sparks to the sole through the shoes.

Have the patient keep one foot flat upon the metal tray connected with the negative pole and lift the other foot from the platform with the sole presenting to the operator. After directing about three single and slow sparks to the centre of the most fleshy portion of the plantar muscles, exchange the feet and repeat the process upon the other. Do this two or three times with each foot.

Avoid the sensitive edges of the foot, the heel, toes and toe-nails, and strike the spark directly in the centre of the sole. This not only warms the feet at the time but by a few repetitions tends to keep them permanently warm, or capable of being readily warmed again by the circulation, if they are exposed to cold weather.

Obstinate Lingering Pains.—When rheumatism has been apparently driven from all the system except perhaps a single joint from which it refuses to be dislodged, I cease, after a reasonable time, to persist in the above methods, but pass through the obstinate part a very rapidly interrupted high-potential current from the small Leyden jars or from my coil apparatus; and if this fails or the indications point to the galvanic current, I employ it before discharging the case.

The sedative and alterative effect of these currents upon pain deep-seated between articulating surfaces is much better than sparks will produce.

As a general rule the relief of pain and muscle stiffness associated with chronic rheumatism will be most successfully achieved by the author's habit of posturing the patient during treatment. Two minutes in this way will often do more for the patient's comfort than ten minutes without, and as a matter of fact some patients who are readily given very satisfactory

results by this aid to treatment have previously failed to find "electricity" in other hands beneficial at all.

Duration of Treatment.—The time required in any given case cannot be stated in a book but can be fairly estimated in practice. I have had a patient come to me, after eight weeks in bed with a pretty heroic course of internal and external treatment, and in seven sessions with static electricity cease to have any of the pain, which had before been so great that he could scarcely endure coming to the office. The slightest movement of his elbow and shoulder was almost intolerable before the first treatment, and the lower extremities were partly affected. Within a week from his fourth treatment he was riding his bicycle with comfort.

I have seen very chronic cases without inflammatory tendency lose more than half their average pain after the third treatment and desist after fifteen or twenty applications, feeling that they were about as well as they could reasonably hope to be.

As acute inflammatory cases of rheumatism confined to bed are entirely aside from the subject of static electricity, and as many of our cases come to us after some years of suffering and various methods of treatment without success, it is fair to consider that two or three weeks for the relief of the most favorable cases, with an allowance of from two to four months for the full treatment of medium and severe cases, is not an unreasonable period for the accomplishment of satisfactory results.

From the experience gained from treating a considerable variety of cases with electricity the practitioner will cease to regard the prognosis as a matter of guesswork, but will find that he can very accurately determine, from his first examination of the patient and at his first treatment, into which one of four classes a given case will fall, and whether he will be able to obtain quick, good, slow, or poor results. He will also be able to distinguish to what extent the rheumatic condition is not amenable to static electricity and will support his treatment by other measures.

While there are occasional demands for the local uses of both galvanic and induction-coil currents in the treatment of rheumatic conditions, by far the major portion of general treatment can be preferably done with static. When other currents will do as well in theory, static will do far better in practice by achieving the same results in a shorter time and without the trouble of any disrobing, either partial or complete.

Although medicine is an extremely necessary part of the treatment of inflammatory types of rheumatism, yet in many chronic cases which have never been acute, and in which medication has proved persistently useless, I prescribe no drugs whatever and the patients thrive very well on static electricity every second day or three times a week, after sufficient relief has been obtained to permit the longer interval.

Clinical Remarks.—It is well to remember that pain in the foot may be something besides rheumatism, neuralgia, or gout.

A patient was once referred to me for "galvanism on his heel"—which had pained him constantly for about nine years. He had been treated two entire years with static sparks and had received no benefit whatever. Another physician had told him that he needed "galvanism." I sent him to a shoemaker for support for his *flatfoot*, and afterwards removed the ache which lingered in the arch with a few applications of a positive static spray, administered to both feet at once, for eight minutes at a sitting, by the brass point electrode, fixed upon the standard. He obtained total temporary relief at each application, which gradually lasted longer and longer, and after four *séances* became permanent.

This case illustrates one of the alleged "failures of static electricity to cure rheumatism."

As a side contribution to the clinical study of the dynamic effects of electricity in rheumatism I will include a reference to workers in electric light and power stations. In the winter of 1894–95, while engaged in some experimental work in the laboratory of a central station, I had several talks with the jan-

itor of the building, a man about sixty years of age, who had in his time, he said, been a great sufferer from rheumatism. He was very much interested in the subject and said that for thirty years he had never long been free from rheumatic pains until the last three years. During these three years he had been employed in and around electric-light stations, and had been free from rheumatism. He asserted that not a single workman in the station had the disease, and it was the general belief among the men that the immunity was due to the influence of electricity from the dynamos.

The facts were made the subject of inquiry through an electrical journal having a large circulation among light and power interests, and an attempt was made by the author to collect data from men of practical experience in this field. The replies elicited were very few in number, but one of them was as follows:

To the Editor of ——:

I saw in your paper an article asking for information in regard to what effect dynamos have on persons who have rheumatism. I will give you my own experience, and if it will be of any use to your correspondent I will be glad.

I was born and raised in Massachusetts and can hardly remember the time when I did not have rheumatism. From the age of ten to nineteen years I suffered intensely with it. Then I came to San Antonio, Tex. For two years I was free from it, although out of doors in all kinds of weather. Then it returned again. About this time I obtained work in an electric-light station in Galveston, Tex., which was the first one in this State I believe.

For four years I was constantly at work in this line, two in Texas and two in Detroit, Mich.

During all this time I was not troubled with rheumatism.

After this I was four years on a ranch in Western Texas, in the most healthful part of the State; here the rheumatism returned again, but not as when I was a boy in Massachusetts.

For the past six years I have been again employed around dynamos, and do not have rheumatism, although it is a very common complaint here and I am exposed to all kinds of weather.

I am not around the dynamos to exceed two hours out of the twenty-four.

CHARLES H. EDDY,
Superintendent Electrical Department of the
Brenham Compress, Oil, and Manufacturing Company.

In central-station work there is generally no direct application of the current, the workmen simply performing their duty in an atmosphere continually in vibration and electrified from the dynamos and wires. Theoretically we can imagine that not only rheumatism but numerous other states of ill health would be benefited by a residence in an atmosphere that conduces to molecular and functional activity. The physiological effects of currents of high potential and high frequency upon protoplasmic metabolism have been pretty thoroughly investigated and determined during the past five years. They are summarized by Apostoli as follows:

Clinical tests upon more than a hundred patients show that these currents exert in the majority of cases a most powerful and generally beneficial action upon diseases due to *slackening of the nutrition*, by accelerating organic exchanges and combustion. This is proved by analyses of the urine made by Dr. Berlioz, of which the following is a brief *résumé:*

The quantity becomes more normal; the products of organic waste are better eliminated. The increase in combustion is shown by the diminution of uric acid, while the percentage of urea is generally increased. The relative proportion of these two substances changes under treatment so as to reach in general the figure of $\frac{1}{10}$. The elimination of the mineral products is also changed, but in a manner less marked.

When daily *séances* are given, each lasting fifteen minutes, we may generally observe in patients submitted to the influence of these currents the following modifications in their general condition. We mention them in the order of their occurrence.

Return of sleep.

Increase of strength and vital energy.

Increase of gayety, of power for work, and ability to walk.

Improvement of appetite, digestion, etc.

In short, general progressive improvement.

This general improvement often manifests itself after the first *séances* before any local influence is apparent, and before any change has occurred in the urinary secretions.

Local pain and trophic changes are often more slowly affected by these currents, and at times they are entirely refractory for a longer or shorter period and in such cases the same currents must be applied locally by contact with the electrodes, for general electrization by any form of current must be localized at the seat of local pain.

The diseases which have appeared to derive most benefit from this therapeutic agent belong to the arthritic class: rheumatism and gout.

In conclusion, the currents of high frequency and of high tension introduced into electro-therapeutics greatly increase the field of action of medical electricity. *They furnish general medicine with a new and valuable means of treatment, capable of modifying more or less profoundly the processes of nutrition through the vasomotor system and exerting a powerful action upon all living bodies subjected to their inductive influence.*

As the statements of Apostoli are now universally accepted as the most authoritative in the field of modern electro-therapeutics I need advance no further argument to explain the *rationale* of the action of static electricity in rheumatism.

The static machine has been from the earliest day to the present time the chief of high-frequency, high-potential sources of medical currents, and in furnishing also the powerful localizing influences of the breeze, spray, and spark, it stands in value far ahead of any substitute "alternating" apparatus that has yet been devised. The one other available form of high-frequency medical apparatus stops in its facility of application and therapeutic effects about where the most active methods of static action begin.

Gonorrhœal Rheumatism, so Called.—In this class of cases, which come to the office with joint pains and without signs of acute inflammation, I detect no practical difference between them and other cases of rheumatism in the indications for treatment by electrical currents.

Under general nutritional applications of static electricity, and localized applications of the breeze, spray, or spark, adapted to the given case, patients with this clinical form of rheumatism do about as well as others.

If some inflammation is present in any particular joint the local application should be either the sedative positive breeze, or the small Leyden-jar rapidly interrupted and mild current, poured steadily into the part between two ordinary sponge-covered electrodes, such as are used with faradic treatment. In

estimating the prognosis in rheumatism the tendency of this disease to relapse must not be forgotten.

Woods and Fritz, in their "Practice of Medicine," thus set forth the treatment of this disorder: "The treatment of gonorrhœal rheumatism is very unsatisfactory. We have never found the salicylates, colchicum, the iodides, or the mercurials to exert a distinct influence for good. In the acute cases, rest, fixation of the joints by splints and blisters, or the application of the thermo-cautery over the joints, constitute the major part of the treatment. In chronic cases careful attention to the general health, the best possible hygienic surroundings, the administration of tonics and of arsenic, and the use of massage and passive movements, comprise about all that can be done by the physician. The utmost importance should always be attached to the local treatment of the genito-urinary organs; the obstinacy of the disease often depends upon the existence of a slight chronic gleet. The surgical treatment of the inflamed joints, by opening and irrigation, is said to have yielded satisfactory results."

Static electricity does infinitely better than this, and will relieve the patient satisfactorily even if it does not always completely cure him. All the remedies suggested above are inferior to the static current in any stage of the disease.

Rheumatoid Arthritis.—Owing to the generally hopeless medical view of this "terrible ailment," it is considered here more fully than some other diseases.

It is one of the cases in which treatment should be directed to the patient rather than solely to the local joint lesion. The disease is progressive and the prognosis unfavorable under medical treatment, but it is my belief that an improvement of fifty per cent in the local condition and vastly more in the general health can be affected by the skilful use of galvanic and static electricity.

Rheumatoid arthritis may in the manner of its invasion be acute or gradual, and the subjects of it may be rheumatic,

gouty, phthisical, scrofulous, neurotic, or have suffered from some local injury, or from some utero-ovarian lesion; but whatever the variety of disease, there will generally be found a nervous system weakened by anxiety or suffering, depraved digestion, spinal irritability, and anæmia.

I quote the following remarks by Armstrong because they contrast well the usual therapeutics with the simple, practical, certain, and cheering treatment to be presently described.

Important points are: (1) Early diagnosis; (2) recognition of the special variety of the disease with which we have to deal; (3) the use of remedies which will act not only on the local joint mischief, but also upon the original cause of the disease, upon nutrition generally, and especially upon the nervous supply of the joints.

[Can any one name drugs having the above actions wherewith to cure rheumatoid arthritis? The author quoted avoids this point and continues:]

As a rule I have found the following drugs and methods more or less harmful, as are all forms of treatment which exercise a debilitating influence, soda salicylate, potassium iodide, alkalies generally, colchicum, bromides, Turkish, Russian, and vapor baths, and very hot immersion baths, whether mineral or plain. Sulphur, guaiacum, and ichthyol have given negative results.

I have found the following remedies of service Salicin, quinine salicylate, iodine, iodide of iron, colchicine salicylate, cimicifugin, viburnum, hydrastin, cannabis indica, red marrow of bone, hypophosphites, nux vomica, sumbul, blisters, and cod-liver oil.

My own experience has resolved itself into about the following plan of treatment, which is modified as different cases require:

If any redness, tenderness, and inflammatory swelling are present in any of the joints, immerse the hand deeply to above the wrist in a jar filled with warm water with a half teaspoonful of bicarbonate of soda added. The salts of lithium are advised by some authors, but I no longer think it worth while to attempt cataphoric medication with this remedy. The results are equally good without it.

Into the prepared jar drop the tip of the positive conductor. If one hand only is affected, the opposite hand in a second similar water-bath may be made negative; but as both hands are usually in the same stage of disease I make both fluid electrodes positive with a bifurcated cord, and press a negative sponge or felt covered electrode, about 3x4 inches area, upon the back of the neck. This requires the least possible derangement of the person's clothing.

Increase the continuous galvanic current gradually from zero up to about ten milliamperes, and maintain this dosage until the most comfortable and complete sedative state in the joints is produced. This may take ten or twenty minutes, but I persist until the effect is secured.

Repeat sittings daily if possible during the first week, or until the pain, swelling, and redness subside. This will usually require a few *séances* only, but the number will of course depend upon the severity and obstinacy of the condition.

At the earliest moment that a mild spark perturbation within the tissues can be set up without exciting fresh inflammation in the joint, I abandon the galvanic current and the trouble of moist electrodes, long *séances*, and purely local action for the greater utility and far-reaching effects of static administrations.

The patient is now seated upon the negative platform with her hands open upon her lap. The dorsal surface is first uppermost. With the brass point electrode and the positive pole grounded to the chandelier I apply a strong, cooling, sedative breeze, concentrated to almost a spray, passing the electrode over each hand within an inch or less of sparking distance. Then up the arm, around the shoulders which are often stiff and painful, down the spine, around the knees which also often ache, and ankles, and to any other locality where stiffness, soreness, or pain resides. When headaches occur, or when the mental state is depressed, a head breeze is included in the [illegible] and when the above-described portion of the treatment [illegible]olished within ten minutes I change the platform

connection to the positive pole and close the sitting with an additional five or eight minutes' nutritional, positive, general electrification.

With each succeeding static treatment after the first the composure of the patient will increase so rapidly that the spine and all large joints and muscles affected with pain and stiffness may soon be vigorously treated with mild sparks. In many cases this general constitutional treatment is of much more importance to the comfort of the patient than is any improvement that could possibly be made in the hands alone in the first half-dozen sittings, especially if applications are made no oftener than three times a week.

There is a definite increase in strength, both nervous and muscular. The entire arms gain in mobility and ease, and improvement in sleep, appetite, digestion, and general nutrition takes place, and the mental state becomes hopeful.

During the subsidence of the last lingering tenderness in the small joints of the fingers the passage from the spray application to mild sparks directly upon them must be slow and gradual, although strong nutritional sparks may be given the rest of the body with impunity.

As soon as tolerance develops in the finger joints the hands are thoroughly treated with sparks of gradually increasing strength, going over every joint and muscle of both palmar and dorsal surfaces.

I have indicated above the cautious manner of initiating treatment when sufficient tenderness and active arthritis are present to require care. But the stage of the disease when the patient first appears for treatment is often such that very strong sparks can be given at once without distress, and in that case the necessity for delay in applying them is absent. The hand, however, in health feels acutely the keen sensation of static sparks, as do all parts of the body which are not well cushioned with muscles to soften the impact of the blow; and when tenderness is exaggerated by disease it must first be lessened and

the change from sedative to stimulating treatment must be gradually made. The precautions required to comfortably administer strong static sparks to the arthritic hand become quickly apparent to the user of the ball electrode, and an inquiry as to the sensations of the patient or even a glance at the expression of the face instructs the experienced operator in the regulation of current strength. These sittings are now usually repeated only three times a week.

In the course of time, which may vary from one to two or three months with different cases, the general condition will have improved so far that the patient "feels well," can use the hands and arms for many helpful purposes, and is entirely free from general symptomatic disturbances, even though the critical observer may see little reduction in the anatomical deformity of the fingers.

I now shorten the static application by omitting the first portion of the *séance* and substitute exercise of the hand and arm muscles by a slowly interrupted Leyden-jar or high-tension induction-coil current and two ordinary sponge-covered hand electrodes.

These are first held in the palm of each hand without regard to polarity, except that I generally reverse it so that each hand gets about as much of one polar action as the other, and the current strength is increased until the whole extent of each arm is influenced.

The electrodes are then localized upon the muscles of the forearms and hands, and particularly upon the wasted muscles of the deformed joints. At first three or four slow contractions to each group of muscles are sufficient, and the number is increased as strength and endurance are developed, in the same manner as in treating ordinary paralysis.

The rate of current interruption should be about seventy per minute, and fatigue and painful contraction are always to be avoided upon the common-sense principles of all rational electro-therapeutics.

Any medication that appears indicated can of course be prescribed at the same time, but these patients have usually "tried" medicine and become hopeless about it. Some declare that they cannot take cod-liver oil, and as a matter of fact our clinical experience teaches us that patients who are given no drugs at all get along very hopefully on electro-therapeutics alone.

I continue to alternate the local treatment of the hands between the induction-current exercise of the muscles, and the resolving, alterative, and tonic action of the strongest sparks which the patient can now receive, together with general positive electrization as long as the systemic state requires it.

PROGNOSIS.—As few persons will continue a long course of treatment without interruption it is difficult to say what the ultimate possibilities of correcting an advanced claw deformity would be; but if we judge results by the general gain in comfort, strength, and increased ability to employ the crippled hands and all other affected parts, we find that long before the hands show any marked return of symmetry the patient is expressing both gratitude and satisfaction over the improvement. It is probable that the best results obtainable by any of the resources of medicine can be best and most quickly obtained by the methods described above, when they are applied with due skill and perseverance. Electricity can without doubt successfully displace and far exceed in value all other remedies for rheumatoid arthritis.

CHAPTER XV.

CHRONIC GOUT AND THE URIC-ACID DIATHESIS.

Chronic gout. Usual methods of treatment. Treatment by static electricity. Prognosis. The uric-acid diathesis. The value of static electricity in this condition. Methods of static treatment. Frequent sittings required.

In addition to the ingestion of large quantities of water, the regulation of diet, and the usual medical formula, the treatment of gouty patients is generally supplemented by baths, exercise, massage, stimulating ointments and lotions locally, etc. The treatment of gout is frequently written up at some length and with great ingenuity in suggesting methods by which extra-drug treatment may be best pursued. Every one of the indications cited in various writings which I have examined is fulfilled by static electricity, and the best and safest means of obtaining all the results which can be accredited to all other extra-drug agencies is found in the hands of the physician who possesses a Holtz machine.

If "active exercise" will benefit a gouty patient the energizing static current will prepare him to take it with endurance and enjoyment, and if he becomes fatigued in an excess of enthusiasm his next static treatment will banish the ill effects. If "passive exercise in the form of massage" is indicated, there is no masseur endowed by training or by capabilities of technique with the deeper-acting, more quickly administered, and infinitely superior massage of the static spark. The potential difference between the hand method and the electric-current method is as great as the difference between a hand machine and a steam engine.

If "baths are indicated to aid elimination," I refer the reader to the investigation of the physiological action of electrical cur-

rents upon inactive processes of metabolism set forth in a preceding page. If a joint can be benefited by "an ointment containing iodine, iodide of potassium, ichthyol, or extract of belladonna spread on a piece of lint applied as a plaster and kept in place by a flannel roller bandage," we have simpler methods that are neither greasy nor odorous, covering all the range, from the sedation of an exquisitely painful and tender state to stimulation, counter-irritation, and strong contractions of muscles and ligaments.

Some of the methods advised, especially "a course of baths and massage or a visit to a mineral spring," take the patient out of the hands of the physician, with an increase of expense to the invalid and no compensating advantage to either the patient or his doctor. The static machine, on the contrary, retains the full, uncomplicated control of the patient, treats him more successfully and with less expense than the masseur or the spa, and gives the physician who operates it the combined satisfaction of serving at once his patient's best interests and his own financial necessities for the support of his family.

Seat the patient upon the platform connected with the positive pole, ground the negative pole, and apply general positive electrification for fifteen minutes. After one or two treatments change to potential alternation, as it is the most actively alterative and tonic method.

Upon this nutritional application the local method must be adapted to suit the case. If a joint is acutely inflamed, swollen, and exquisitely painful and tender, the patient will hardly be likely to come to the office and will be treated by the usual methods at his house; but should the condition be such as to permit office visits, the relief of the positive static spray concentrated upon the part for about ten minutes will be a wonderfully efficient aid to the "calomel, colchicum, codeine, and other drugs customarily prescribed." Repeat as often as the return of pain and circumstances indicate. The patient who has once experienced the great relief of the static breeze will want it again.

If the joint condition is one in which "local massage is said to be of great service" the local static application may begin tentatively with sedation, if a low grade of inflammation is suspected to be still present, and the operator may gradually mingle an occasional mild spark with the sedative and alterative spray, but increase the dosage to stronger sparks as the improvement advances. This will massage the joint most effectually.

If there is only deformity present without inflammation it is advised that "the massage may be more vigorous, and movements of the joints with stretching of the contracted ligaments should be frequently and systematically carried out. By this means the deformities, when they are due to contraction alone, may be entirely overcome and the full use of the joint restored. The application to the joint of stimulating ointments and lotions is also of considerable value. Of course, if there are chalky deposits within the joint they can never be removed."

Under these conditions apply to the joint long, thick percussion sparks, carefully regulated from very mild to strong, according to the increasing tolerance of the tissues in the course of improvement. Avoid applying the spark to any node or bony prominence uncovered by muscle if the spark causes any particular pain in this situation.

To affect the gouty diathesis after the patient has become accustomed to spark treatment, close each sitting by a thorough nutritional treatment of the whole body. Go over the spine, arms, abdomen, region of spleen and liver and entire lower extremities with positive sparks.

Frequency of treatment must be governed by the duration of the effect after each sitting. When the improvement is maintained for more than twenty-four hours and is progressive, the applications may be made every second day and later three times a week. When the patient remains free from symptoms and maintains a satisfactory improvement for an interval of about two weeks, treatment may be discontinued until some relapse occurs.

In all this class of cases it is sufficient satisfaction to be able to keep the patient comfortable year after year by temporary treatment whenever symptoms require, but the tendency to relapse would of course be greatly mitigated by adding to dietetic precautions an occasional short course of static treatment at intervals throughout the year, regardless of any apparent necessity.

The Uric-Acid Diathesis.—The medical man who operates a powerful Holtz machine in his office practice possesses a means of mastery over this renowned condition that far surpasses the therapeutics of Haig. The diet-and-drug method strives to adapt the patient to the diathesis, in fact capitulates to it; supplementing these measures with static electricity drives the diathesis out and necessitates no compromise with the powers of malnutrition.

Nerve and muscle excitation are the familiar electrical effects commonly quoted by those who have no other knowledge of electro-physiology, but these are far surpassed in nutritional importance by the decisive effect upon the metabolism of the organism by currents of high frequency and high potential. Apostoli and D'Arsonval have lately demonstrated, and many others have confirmed, this profound effect upon nutrition,* increasing the elimination of urea, carbonic acid, and water by from forty to fifty per cent, and reducing by a corresponding amount the uric acid in the system.

On the one hand the consumption of oxygen is increased, metabolic completeness is increased, and the products of incomplete combustion are diminished on the other hand. It is certainly better therapeutics to dispose of uric acid by carrying its oxidation on to urea than to prescribe solvents which do not lessen its production and which only palliate the evil.

The treatment of these cases by the addition of static electricity to other methods involves the general application of the

* These effects were practically observed and recorded by the careful and accurate investigators of 1770–90. See chapter on electro-physiology.

positive current, preferably by the author's vibratory potential alternation, followed by nutritional sparks to the general surface, and the localization of either breeze or sparks wherever they may be needed for the relief of painful or other symptoms presented by the patient.

While the sense of well-being imparted to the patient in a few moments is exceedingly grateful and may last for a few hours, or the remainder of the first day and night, yet if the apparently prompt relief deceives the physician into short sittings at intervals of only about two or three times a week, the progressive advancement of the case will not be rapidly assisted.

Inasmuch as the processes of nutrition are at fault, and are taxed beyond their functional powers three times a day, it is evident that one treatment in three days has too much against it to permit its successful operation. The improvement which follows a few moments' influence of the current should not only be maintained by treatments of nearly half an hour in length, but the second treatment should take up the benefit and carry it on before it is partly or wholly lost by delay. The most satisfactory results in the treatment of these patients will be obtained by thorough nutritional applications daily, until there is no gain lost by making them every second day. When improvement is established to this point it will soon be possible to finish the case with a few treatments three times a week. Repeat the same when relapses occur.

CHAPTER XVI.

NEURALGIAS AND NEURITIS.

Resources of static electricity. Supraorbital neuralgia. Method of treatment with different forms of static breeze. Facial neuralgia from use of hair tonic containing lead. Neuralgias in general. Methods of treatment affecting different parts of the body. Duration and frequency of application. Prognosis. Sciatica. Successful treatment. Static methods in full. Auxiliary medication. Clinical cases. Comparison between static electricity, the rest cure, and other methods. Traumatic neuritis, and recent or chronic effects of cold and damp.

"So nearly certain is electricity in some form to relieve an idiopathic neuralgia that if proper electro-therapy fails, time will usually show a severe pathological condition to exist in the vicinity of the nerves—as, for instance, neoplasms, an abscess, or some severe general bodily ailment as diabetes" (Benedikt).

The commonly recommended blisters, cups, cautery, rest cure, and all the analgesics of the materia medica cease to interest greatly the physician who is able to command the resources of electrical currents, although at times in the beginning of a very severe case some temporary aid to sleep may be advisable. If also any case of neuralgia presents clear indications for curative drugs they will be given the practical preference by most physicians and patients. The neuralgias that come to the electro-therapeutist are mainly of an inveterate character and have already resisted drug action.

Static electricity contains more than one valuable resource with which to combat, and at least palliate, and often in time effectually cure, this frequent and distracting form of pain. Positive electrification is a general nutrition improver; the positive breeze is a local sedative; the negative breeze and spray

are stimulating, and the friction spark is counter-irritant; the long thick spark is a powerful agent for good within muscular tissues, while the rapidly interrupted Leyden-jar current of high potential and high frequency is sedative and corrective in still another way.

Supraorbital Neuralgia.—The first electrical procedure to try is the positive static spray, rather than the galvanic or high-tension induction-coil currents, because it is not only the most simple and often very effective application, but it involves also the constitutional benefit of general as well as local treatment.

Seat the patient upon the negatively insulated platform. Ground the positive pole and brass point electrode to the gas fixture. With the machine in moderate action apply a concentrated positive spray upon the site of pain until it is removed.

The point of the electrode should be held within a short distance from the surface—just beyond sparking distance—and kept in gentle motion over the affected area. The use of the hand electrode in these cases is preferable to a fixed electrode upon a standard, as it can be instantly and always under the control of the operator, regardless of any movement of the patient's head.

The delightful nature of this application will sometimes induce the patient to bend the head nearer the electrode, and use of a standard with the liability of a spark which is not wanted is imprudent.

Add to the local application a general nutritional *séance* of five minutes. To apply a static spray to the face or any part of the head without sometimes startling the patient by a vagrant spark will be found to require some manual dexterity and careful attention to the treatment.

If the general condition of the patient is such that positive electrification instead of negative is especially desired, the breeze must be applied in another way.

Connect the platform with the positive pole. Ground the negative pole to the water pipe. Do not employ the brass

point, but fix a fine wire spray electrode upon the standard so that it will present its multiple needle points in front of the supraorbital nerve, at a distance of two or three inches—the exact distance depending upon the rapidity of the machine and the vigor of the current.

Ground the standard to the gas fixture, instruct the patient to maintain the average distance from the electrode, but to turn the head gently from side to side so that the breeze will play like a refreshing zephyr across the forehead and upon the temples.

Start the machine into action very slowly, and cautiously increase the current until it is as strong as it can be made without risking a spark. The chin must be tilted up so that the breeze does not irritate through the hair. Its sedative effects depend upon its application to an uncovered skin. If the electrode is removed farther away—ten to twenty inches—it not only becomes diffused when it should be concentrated, but loses its soothing character and is exceedingly irritating. The secret of many good effects of the static breeze depends upon concentration of action, and when it is diffused, either by the size of the electrode or the distance at which it is manipulated, the sedative effect is lost.

Apply either form of breeze until the pain is entirely relieved, and for several minutes thereafter.

These two methods, one with negative and one with positive electrification, may be employed, and experience rather than printed directions will suggest the choice between them. If they do not afford a relief which gradually endures for a longer interval after each *séance*, with promise of becoming permanent, the case is not suited to this form of current. The static spray, however, in experienced hands will fail less frequently than many other much-praised remedies and we still have left the galvanic and coil currents and cataphoric medication among the untried resources of medical electricity.

Facial Neuralgia from Use of Hair Tonic Containing

Lead.—Seat the patient upon the static platform connected with the negative pole, ground the positive pole and brass point electrode to the gas fixture, start the machine into moderately rapid action, and hold the point persistently within a short distance from the seat of pain for from five to eight minutes, or not less than two minutes after all pain has ceased.

The spray should be so concentrated as to present the visible bluish discharge, but not contain any sparks at first, although as soon as the patient is accustomed to treatment I always let a few mild sparks pass to the muscles from the point of the electrode in addition to the spray. Repeat this treatment daily until relief lasts longer, and then as needed till entire recovery.

While at the beginning the hair tonic will of course be stopped, and potassium iodide administered internally to eliminate the lead, yet the static spray will not wait for the action of this remedy but will at once afford the patient a character of relief that is unspeakably grateful. I have even relieved such a case without any iodide at all.

Neuralgias in General.—For neuralgias in general, affecting the face, head, hands, feet, or any bony part to which sparks cannot be readily applied because of lack of muscle covering, the first choice of method is the positive spray, with the patient insulated negatively, and the positive pole and the brass point electrode grounded.

In concentrating a decided spray upon the seat of pain I always keep the electrode in gentle motion and near enough to establish a visible brush discharge which is my guide to the strength of the dose. For this reason I generally have the patient sit so that the part undergoing treatment is in the shadow.

When the static machine is operated with a motor the plates will almost instantly increase their speed, as the electrode attracts from the patient the accumulated charge, breaks down the insulation, and lessens the resistance against which the

machine works. For this reason the electrode must be managed with skill to regulate the proper strength of the application, and if the plates become too rapid the street current should be cut down to lessen their speed.

It is an important point to persist until pain is gone. In favorable cases this will occur in a very few moments, sometimes in a single minute, but I generally continue the spray for about double the time which elapsed before the pain ceased, or a total of from six to ten minutes.

Close the *séance* by devoting five minutes to general nutrition treatment adapted to the state of the patient.

Sittings should be repeated with reference to the severity and frequency of the paroxysms. My usual plan is to secure daily sittings if possible for at least the first week, and then adjust frequency to the needs of the case as they develop.

By the joint aid of static and galvanic currents the great majority of neuralgic pains can be satisfactorily relieved regardless of a differential diagnosis as to the cause, and with permanent results if the cause is also one which is amenable to their action.

In neuralgias affecting nerves below the neck, in regions covered with muscle, the static spark is probably more effective than any other treatment. It is not always so with pain in regions of bone and ligaments, for it is then disagreeable and less suited to the case. Deep visceral neuralgias also do much better with other currents than with ordinary static, although sometimes they do very well with sparks.

The great sphere of static electricity in the form of sparks is in parts covered with abundant muscle substance, in which contractions develop and increase the actions set up by their nutritional blows.

The anodyne effect of a single static treatment of a severe and chronic neuralgia will necessarily be short, as would also be the best effect of any single dose of medicine. Therefore sittings should in obstinate cases be made as often as pain de-

mands, unless some palliative that is not harmful can be satisfactorily employed between sittings which are farther apart.

In a great many cases circumstances and the financial or domestic affairs of the patient decide such matters rather than the exact therapeutic indications. Effectual cure, however, must be looked for in chronic cases along the lines of gradual nutritional improvement rather than from local and simply pain-relieving applications. Therefore every static sitting should aim at constitutional benefit, and the relief of any present pain is to be regarded as only a part of the patient's needs.

Sciatica.—Insulate the patient with the platform rod attached to the negative pole of the static machine. Ground the positive pole and electrode to the gas fixture.

If the case is acute, with considerable tenderness to pressure, use first the brass point electrode moved agreeably over the painful parts with two or three inches of spray gap. Keep the machine in moderate action. Gently soothe the entire limb and lumbo-sacral region in this manner for about ten minutes, and apply only a few mild and cautious sparks at the close of the first sitting.

If the case is subacute or chronic, a thorough course of percussive sparks judiciously regulated in strength according to the varying tolerance of the tissues between the ankle and the spine will be effective if properly given.

Begin with very mild sparks and posture the limb variously in every position and degree of muscular tension that can be discovered to aggravate the pain.

In every posture spark the painful point until the pain surrenders, and persist at each *séance* until relief is complete, and the patient steps actively about the room without any pain whatever.

If this degree of relief is obtainable and lasts for a longer and longer time after repeated sittings, the prognosis is favorable for one of the satisfactory cures which do so much to gratify suffering patients.

If absolute relief is not obtainable, either the skill of the physician is at fault or the case is less suited to static electricity. Rheumatism of the hip-joint must not be confounded with a sciatic neuritis or neuralgia in estimating the prognosis, nor, if the patient is a woman, should static sparks be expected to cure a case which should be referred to gynecological methods. My remarks here refer to ordinary sciatica of the form that it is usually expected medical measures will relieve.

Having obtained satisfactory relief from the first application of local sparks, apply sparks to the entire spine and other limb to promote nutrition and advance the improvement.

Repeat sittings daily until pain is absent for more than one day; then repeat every second day, and if the case is chronic continue treatment two or three times a week till improvement ceases. In all cases, either acute or old, several treatments should be administered after all symptoms have disappeared.

Medication for anæmia, malaria, syphilis, or any other associated state of disease which can be improved by appropriate remedies is always in order, but drugs directed especially to the sciatica will not be needed.

In the early stage of the treatment of a severe case, even if the patient is treated once a day, the relief from pain cannot be expected to last twenty-four hours after the sitting, and in private practice a temporary aid to comfort and sleep may be prescribed when the state of the patient demands it. To conquer the sciatica, however, I depend solely upon the static administrations.

From a comparison of my experience with the reports of some other physicians who state that they have been disappointed with the results of static sparks in sciatica, I am inclined to place a high value upon the postures I employ. I have repeatedly taken the electrode from the hands of another operator after the total failure of routine sparks to control the pain, and have relieved the patient satisfactorily in a few moments. Skilful posturing during the application of properly

regulated sparks is one of the chief secrets of quick results in all muscular pains which are made worse by movement.

If the case is not sciatica, but is an arthritis of the hip-joint, the spark is at a great disadvantage for reasons fully explained elsewhere, and although considerable improvement can be effected in hip-joint rheumatism by static electricity, the decisive results obtained in a neuritis or neuralgia of the sciatic nerve are not to be expected.

Almost every physician, however, who has a Holtz machine cures his cases of ordinary sciatica with static applications.

Case reported by Dr. F. A. Kraft, Milwaukee, Wis.:

Sciatica.—Mr. C. F——, a gentleman of 44 years of age, came under my treatment for sciatica of thirteen months' standing. Pain was very severe, especially in the sciatic notch, but less over the distribution of the nerve. In the afternoon it became more general and even affected the whole spinal region up to the shoulders, increasing in severity so that the gentleman was obliged to take an injection of one-fourth to one grain of morphine almost every day for nearly two months before calling at my office. He came for static electric treatment, determined to quit medical agents, and although I advised some glandular remedies to promote absorption, he emphatically declined to take any.

I started with the static applications of the breeze, first with the wood electrode, and particularly on the distribution of the sciatic nerve, the spinal cord, etc. After the second treatment the full spark with the brass ball electrode was applied and I finished every treatment with three to five minutes' head breeze.

The patient improved wonderfully, and particularly after the sixth treatment the progress of the cure was rapid and pleasing. The patient received eighteen treatments altogether, after which all symptoms subsided. This has been nine weeks previous to my writing these lines. The patient still runs up to the office for treatments though it is not necessary for him to do so, but he says once a week I want an electric head breeze which is the best shower-bath to clear the brain. Otherwise he is in the best of health.

One word more about static electricity and also one about "static machines." I have seen and tried different static machines and some with two, four, and six plates. The one I use

at the present time is the Van Houten and Ten Broeck machine with eight plates.

Case reported by Dr. Franklin H. Clark, Cleveland, O.:

Sciatica.—Mr. T. S——, aged 58, married, Italian, seven years ago was taken quite suddenly ill with sciatica.

Was treated at home for some time by a native physician of Rome, but did not improve. After three months of home treatment was taken to the hospital, and after two months of hospital treatment without any improvement was operated upon and the sciatic nerve thoroughly stretched. Slight improvement followed the operation for a short time only, and then the condition was just as bad as ever.

Three months after the first, a second operation similar to the first was followed by slight improvement for a short time, and then he was suffering as before.

Patient remained in the Roman hospital over four years, and was operated upon five times, and was treated by all known drugs for that disease, without any marked improvement. He was then sent to America, thinking this climate might do him some good, but he gradually got worse. Was obliged to move twice in this city, as the neighbors complained that he kept them awake at night by his moaning.

Two years ago he was brought to my office in an ambulance; left leg swollen to twice its natural size and exceedingly painful. Patient very pale and badly emaciated.

Applied static shocks with large Leyden jars for ten minutes, relieving pain very much, repeated this every day for one month. Patient could then walk one-half mile to my office. Applied the electricity every day or every second day, for nearly one year; discharged him cured.

He has been doing the heaviest kind of manual labor for the last year, without any return of the trouble.

Clinical Cases. Mr. . . . , aged 30, right leg attacked five months ago. First tried neighborly recommendations, then patent medicines, then druggist's prescriptions, and finally went to a physician. After an experience of five months he was wellnigh distressed with pain, and concluded to "try electricity." Called at my office August 18th, 1893, was suffering severely and was barely able to walk without crutches. The sole treatment given him was positive electrification with sparks for five to ten minutes. Result: The first treatment gave a complete relief from pain which lasted for half an hour, when pain returned as severely as before.

August 19th. Relief lasted about the same time. 21st. Relief from this treatment lasted a little longer. 22d. The fourth treatment gave relief from pain for about nine hours. 25th. Reports he is very much better. Can walk comfortably and stoops without pain. 26th. Feels nearly well. 29th. Has some pain yet at times, but thinks he is about three-quarters cured. 30th. Reports continued improvement. 31st. Had no pain for nearly the whole twenty-four hours just past, and sleeps restfully.

September 8th. Reports that he had had no pain since his last visit and has returned to his occupation. 11th. Last treatment. Reports entire relief.

Several months later a relative informed the author that he continued to be well.

Mr. ——, right limb affected, duration five months. Sensitive points: middle of thigh, popliteal space, calf of leg, behind external malleolus; pain constant, difficulty in getting up and down; knee jerk exaggerated; impaired nutrition; thin and worn-looking. April 27th to May 13th, 1892, seven treatments; improved nutrition; gain in weight; pain gone; free movement.

Mr. ——, clerk, four years. Onset sudden, worse in right leg; constant pain; worse before storms and in rainy weather. December 21st, 1891, to February 5th, 1892, seven treatments; recovered; able to stand at work all day. November 23d, 1892, presented himself for another trouble; no return of the sciatica.

Mr. D. D——, painter, six weeks. Painful points: sciatic notch, middle of thigh, and below head of fibula; leg held stiffly in walking and slightly flexed; extreme pain; worse on movement; was taking opium; twenty-one treatments; discharged recovered.

Mr. A. H——, clerk, nine months. Left at first affected, then right. Pain in sacrum, sciatic notch, popliteal space, and to foot; cannot sleep; knee jerk scarcely evokable in left leg. December 14th, 1891, to March 2d, 1892, thirteen treatments; pain remarkably relieved after five treatments; after six, able to sleep until 5 A.M., and go to work. After nine, at work all day, standing morning until night. Recovered.

B. M——, drives ice wagon, nine months; great pain; could not sleep; impaired nutrition; worn and anxious countenance;

impaired mobility; walked with great difficulty. October 9th to December 14th, twenty-eight treatments; no pain, walks well; improved nutrition; gain in weight; able to go to work.

Mr. S. B——, six months. Pain: sore on pressure at popliteal space; difficult locomotion and impaired mobility; walks with cane only. August 31st to November 6th, 1891, sixteen treatments; walks without cane; no pain or soreness.

Mr. S. S——, four and a half years. Onset sudden, back and left leg, then right leg; has been in hospitals and taking medicine and galvanism off and on ever since. Pain; cramps; shortening; walks only with cane; could not get on or off insulated platform without help. October 28th, 1891, to December 30th, 1892 (fourteen months), seventy-eight treatments; gets on and off platform without help; walks everywhere indoors without cane; no pain; no cramps.

Mr. M. P. B——, watchmaker; pain site of old sword wound, two inches to left of the third dorsal spine; pain constant, increased by motion and cold; "darting," "sticking" character; deep superficially burning sensation even to light touch of shirt. Four treatments and continued relief from pain to date.

A recent contributor to a medical journal remarks that "sciatica is a dire affliction which seems to tax the ingenuity of the average prescriber to such an extent that in the depth of his perplexity he calls for the observations and methods of others to aid him." An authority upon materia medica thus comes to his written aid. "Internally arsenic, iodide of potassium, aconite, cimicifuga, and turpentine offer the best means of relief in the treatment of sciatica. Externally massage, acupuncture, chloride-of-methyl spray, extension, actual cautery, blisters, and the application of precipitated sulphur to the whole limb sprinkled over flannel and covered with oiled silk. Injections of morphine, atropine, and sulphuric ether afford but temporary relief, and sometimes even aggravate the pain."

This list omits one very important remedy for sciatica, viz., static electricity. The administration of an anodyne is a very different matter from effecting a radical cure. The list of

medicinal remedies for sciatica is long, and by consulting various authors it may be increased indefinitely. But the prominence everywhere given in practice to hypodermic injections of morphine, or to the administration of some analgesic, is proof alone that there is no curative drug approaching electricity in value.

Cases have come before the writer with long histories of every possible form of treatment, some of them involving intense suffering in addition to the disease. They have come with scars on their bodies and profound discouragement in their minds (and occasionally resentment for the useless torture to which they have been subjected) and they have promptly begun to get well under static sparks.

To effect a cure we must undoubtedly act upon the nutrition of the central trophic cells and the substance within the sheath of the nerve itself, for some degree of structural change in some part of the nerve cell or its prolongation is probably present in all the manifestations of pain which we ordinarily call sciatica. Prominent authors contend that it is useless to speak of sciatica without an associated neuritis, which may be acute, subacute, or chronic. While the static spark may be theoretically contraindicated in some cases of sciatica, it is most usefully applied in practice by expert static electricians without regard to orthodox or popular theories.

The painful point and entire nerve course are subjected to a powerful static spark and they cease to ache, and the relief of pain for a brief time after the first treatment will gradually lengthen under repeated treatments until the relief is permanent.

No other plan of treatment known to the author will produce equally swift and certain results; and the cases of this affection which static electricity fails to cure, if it is administered by competent hands, will be found to be some other disease or pain dependent upon some cause, either incurable or removable by surgery alone. It is stated by a practitioner who has many

followers that in cases of sciatic neuritis "rest" is a most important agent. The so-called "rest cure" has therefore been in certain quarters a fashionable fad. After "eliminating rheumatism, gout, syphilis, injury, and pelvic growths, and deciding that the case is one of neuritis only," it is considered that—

The most certain indication is to secure rest, not simply by keeping the patient in bed, but by means of a long splint. An old-fashioned long splint from the axilla to the foot may be used, or a roughly moulded anterior splint with a wooden attachment carried up laterally to the waist or axilla.

The ankle must be sustained so that the heel does not carry the weight of the leg; the knee must be gently flexed and the angle of flexion changed a very little at each dressing.

After a few days of undisturbed rest all the joints must be carefully and slowly flexed and extended to a slight extent, to prevent too great stiffness, the common evil which follows the use of the splint. Only sufficient bandage to keep the splint in position should be used. If the patient cannot bear a long splint, an anterior suspension splint may be of some service.

By this simple [?] treatment "many cases of chronic sciatica may be overcome which have defied more elaborate treatments."

If the case be not cured by these means, the daily use of Paquelin's cautery button at the painful points is recommended. If still obstinate, employ dry *cold*. A rubber ice-bag is kept on the painful nerve day and night for two or three weeks, or the leg is placed in a tin or copper gutter on the under part of which is an ice case three to four inches wide.

As the pain diminishes, the use of cold is lessened until it is only applied at night or for an hour or two twice a day. If any pain points remain, the use of the cautery is often valuable, but is apt to interfere with massage treatment which is so helpful at this time.

Kneading of the muscular masses of the leg, and also a gradually deeper surface rubbing in a downward direction over the nerve trunk for half an hour twice a day, is now employed.

When the pain has disappeared, it is wiser for a while that at first the patient should stand aided by crutches and then walk with them, and not sit up long as this brings pressure on a nerve which may still be sensitive.

Often the patients are thin and anæmic, and general massage is of service after the "rest" treatment has been employed for some time; but at first it must be avoided in order that the resting limb may not be disturbed.

Strong galvanic currents may be of service in the milder forms

of sciatic neuritis, but this treatment is as painful and less efficient than the cautery.

If the wasted limbs do not gain in size and tone at the close of treatment, the stimulation of the induction current may aid in producing a more rapid result.

The treatment of chronic sciatica by splint, rest, and dry cold as above described is more apt than any other means to effect permanent cure, and it has many times triumphed when all else had failed.

The "simplicity" of this elaborate plan of treatment could scarcely commend itself to the physician accustomed to seating patients upon his static platform, applying sparks for five or ten minutes, three or more times a week, meanwhile allowing them to attend to their ordinary affairs and curing them usually in from ten to twenty treatments.

Neither could it be considered especially simple by the victim of sciatica who had to choose between its somewhat tedious if not exceedingly tiresome procedures, and the alternative of static sparks.

The method has been referred to here at an unusual length because the disease itself is of frequent occurrence and of sufficient importance to receive our fullest consideration; and because the method outlined affords a most remarkable contrast in every way to the treatment by static electricity.

To present this contrast clearly let us turn from our account of the rest cure to an ordinary case treated by static electricity. A physician reports:

Mr. M—— came to me suffering with sciatic rheumatism, worse on the right side, running down the limb. The pain at times was very severe, cutting like a knife, and greatly aggravated by motion.

Treatment: Negative electrification, five minutes. Breeze on spine, five minutes. Massage roller over lumbar region and down the right limb for eight or ten minutes.

His experience of the relief given during the treatment was constant; and a month's treatment cured him of his sciatica.

The author of the rest treatment states that he has never met with a case of sciatica in which he was obliged to resort to "nerve-stretching," and points out the fact that nerve-stretch-

ing is liable to fail, like all other means. In this last statement I fully concur, but cannot agree with the same writer on another point. In his allusion to "all other means" (except his own method), he omits static electricity, and for this agent the following advantages may be conservatively claimed and clinically demonstrated.

1st. It is applicable in practically all non-operative cases, and we are not obliged to "eliminate rheumatism, gout, syphilis, trauma, etc., and decide that the cause is solely neuritis."

The number of cases in which static will totally fail is very small. In most cases it will produce at least some immediate benefit. In the majority of cases it will produce curative results if fairly tested, and in recent cases often acts like magic. It would require considerable proof to convince me that any single agent surpasses it in the treatment of sciatica.

2d. The patient is not inconvenienced by forcible detention in bed.

3d. The application of splints, dry cold, bandaging, flexion, extension, kneading, dressing the limb, etc., which evidently require a skilled attendant and a great deal of time, not to speak of the tax upon the patient, are entirely done away with in static treatment.

4th. Long and enforced rest impairs the muscles in tone and function; sparks give firmness, activity, and strength to the entire limb thus treated. No muscles can waste away under static sparks.

5th. Relief is manifestly more prompt. In fact the patient steps from the platform free from all pain at the end of the first and each succeeding treatment, and this relief in time is usually permanent.

6th. If a cure is effected it is done in much less time.

7th. If static fails, its failure will be quickly demonstrated so that little valuable time is lost and other measures may be tried, while all medicinal indications may be fulfilled from the very commencement.

8th. If the patients are "thin, anæmic, rheumatic, paralytic," etc., the static treatment is directly beneficial to these existing conditions. Scarcely any better could be devised.

9th. No "painful cautery buttons," or other "painful" auxiliary aids are required.

10th. When the pain has disappeared the patient is not weakened and wasted by long inaction so as to require "massage, faradism, and tonics to build him up, and crutches to assist in standing and walking," but under static sparks he has been gaining strength, and muscular activity and endurance, hand-in-hand with the disappearance of the pain.

To the author of this work these seem advantages that would have peculiar weight with the patient as well as with the general practitioner, although it is readily surmised that with the resources of a sanatorium to admininister the details of the rest cure, the longer method would possess an undoubted financial attractiveness.

Traumatic Neuritis, and Recent or Chronic Effects of Cold and Damp.—Seat the patient upon the static platform, insulated negatively. Test the tolerance of the part affected with a gentle local application of the mild positive spark. If the spark is not tolerated in an acute condition, a positive spray may be applied for the relief of pain until improvement permits a spark. Cases, however, rarely come to the office in a state into which some intensity of spark cannot be applied by at least the second treatment, with positive and progressive benefit thereafter.

In all chronic cases the spark is certainly *facile princeps*. Use it with judgment and care equally to avoid "too little" and "too much," and no other form of treatment will be required for ordinary cases. Repeat as often as needed for relief of pain and acute symptoms, and continue later treatment three times a week.

Some of the most interesting effects of static electricity are observed in the treatment of neuritis and associated pains.

When a so-called neuralgia is caused by an inflammatory exudation somewhere in the nerve sheath—an exudation which must be absorbed to obtain relief—then static sparks are certainly the sovereign remedy. Not only are galvanic and faradic currents more troublesome to apply, as they require the removal of clothing, but their curative effects in these cases are decidedly inferior to the powerful, deep-acting, anti-congestive, anodyne, and nutritional spark.

If inflammation has proceeded to destruction of nerve tissue, with wasting and degeneration of muscles, the treatment should be supplemented by the use of a slowly interrupted Leyden-jar current in the same manner that the faradic current is employed in other atrophic and paralytic states.

CHAPTER XVII.

NEURASTHENIAS.

Simple and symptomatic. Acute or chronic. Static electricity the sheet anchor of treatment. Operative methods. The treatment of local symptoms in neurasthenic cases. Constitutional benefits of general electrification in neurasthenia. Differential indications. Frequency of treatment. Auxiliary medication. Prognosis. Facility of static methods. Principles governing current action in neurasthenia. Clinical remarks. Beard's symptoms.

THE successful treatment of neurasthenia requires the co-operation of the patient with the physician. The sheet-anchor of nerve-renewing force is electricity. Rest must economize and accumulate its benefits, and in some cases appropriate drugs must assist at the start, but the chief part of the work can be done with static electricity. Neurasthenic states, nervous break-downs from mental or physical overtax or insomnia, with either local or general manifestations, present a great many difficulties to symptomatic drug treatment.

Treatment.—In the beginning treatment must often be modified greatly, to initiate the patient rather than to attack the disease. The simple electrification and breeze methods are first to be employed, and if sparks are regarded as desirable they can wait till the patient is ready.

Seat the patient in a comfortable and high-backed chair upon the static platform and in the most restful position for complete nerve composure. The first tentative electrification should be negative and mild if the patient is a stranger and full of unfounded fears.

Attach the negative pole to the platform, ground the positive pole, start the machine into slow action, observe the tension of the hair and the increase of the patient's confidence, and follow this up with gradual increases of the current strength.

In about ten or fifteen minutes close the first sitting. Attempt nothing else. Do not touch an electrode or go near the patient while she is insulated. Let her reassure herself and get some benefit before the next step in advance is undertaken.

Upon the second visit, or at the first, if no particular caution seems necessary, make the electrification positive, but see to it that nothing in the room near the platform exerts an attracting influence to disturb the patient's composure.

Until the patient is prepared by established confidence to let the operator employ electrodes, no local application should be attempted. It is necessary to speak of this because a neurotic patient may occasionally be lost by too much vigor during the first sitting. Personally, I am in the habit of commanding full confidence at the second visit and usually at the first, even with patients never seen before, but only the mastery of practical experience will enable the physician to do this, and it is better to go slow rather than to hasten too fast.

The duration of each *séance* of positive electrification is governed by observing the effects. When the patient perspires freely it is a sign that the stopping-point for the day is reached, provided the diaphoresis is not due to the warmth of the room and the retention of heavy wraps during treatment.

In all cases there may wisely be a gradual advance from short to long sittings, but in saying this it must be noted that the expert can often produce effects in ten minutes that a novice would waste half an hour in securing. Nevertheless a half-hour of restful and restorative simple positive electrification is sometimes the best treatment that can be given.

The next step in procuring a general tonic and active nutritional influence is by the author's method of potential alternation. Begin the *séance* by positive electrification as usual, adjust the brass ball electrode upon the standard and administer the vibratory current, regulated in spark length to a comfortable intensity, for ten minutes longer; then close the sitting with any local applications that are required.

By this time, in the majority of cases, the gain in nerve composure, sleep, well-being, appetite, and spirits is manifest. The patients now eagerly crave the static bath and spontaneously look to it as the means of restored health. Its benefit is self-convincing and no assurance that it will do further good is needed; the stanchest advocates of static electricity are the patients themselves.

We are now ready to attack local symptoms with the brass point breeze electrode. Do not begin with sparks unless you know your patient, know the spark action, and have confidence in your skill; for sparks are somewhat energetic in irritable nerve states, and they should be known to be necessary before they are used.

The first attempt of the breeze should be made with negative electrification. Stop the machine, remove rod from positive pole, transfer it to the negative, and ground the positive pole and breeze electrode. I pay no strict regard to whether the neurasthenia is cerebral, spinal, sexual, or to any other limiting diagnostic phrase. I consider the patient "sick all over" and treat her or him accordingly with the most thorough constitutional administration possible. Upon this general benefit I engraft such local benefit as symptoms call for. This is practical medicine as opposed to text-book theory.

To culminate the constitutional benefits of general elecrification I close the sitting or begin it, either one, with the most complete sedative, or sedative-tonic, or stimulating-tonic, or even counter-irritant effects I can produce with the point electrode, with either positive breeze or spray, or negative breeze or spray, or rubbing frictions, as these in turn are indicated and as the case is ready to receive the application.

During the use of this electrode it requires but a little time to concentrate upon an aching, congested, irritable, or painful point of the spine, head, pelvic region, perineum, muscle group, hands, arms, legs or feet, the localized effect that the condition calls for.

Upon the vertex, forehead, or the base of brain, headaches or congestions in these regions take more time to relieve by sedation than is required to stimulate nutrition in other local parts, and I therefore usually complete the application by a positive breeze from a fixed electrode directed toward the one of these situations which causes the complaint.

When a quick cutaneous and reflex stimulation can be beneficially applied to either the local part of an aching spine or to all the muscular surface of the back and extremities, this can be done by friction sparks in two or three minutes or less without removing a garment. The effect differs markedly in sensation from general faradization but in lasting results it is not less efficient and takes about one-fifteenth of the time and trouble.

This counter-irritant and stimulating effect is produced by a very quick rubbing of the large brass ball electrode over the surface of the clothing in close contact with the patient. With negative electrification it is less sharp and hot than with the positive high-potential charge, but in either case the novice should try it on himself and learn how to consult comfort before he rashly ventures to treat a patient with this profoundly revulsive and intense application.

When improvement has proceeded so that the strengthening of muscles can be begun by the use of sparks, or their deep-acting effects applied for other needs, they should always be mild positive sparks given at the latter part of the *séance* and increased in vigor with some prudence.

All these needs for caution cease to a great extent as soon as improvement is well under way. The patient will gladly welcome treatment as soon as she discovers its benefit, and the timidity of the period of strangeness vanishes forever.

In clinical experience I find that patients who attend three times a week, receive no medical aid, and who return to their ordinary household duties, derive great benefit from static electricity alone; but they do not get rapidly and permanently well

in chronic cases, especially if they come a fatiguing journey to reach the office and repeat it going home. They spend strength at home as fast as they made it during treatment, and about all that can be done is to keep them able to do more work than they did before. In even these cases, however, static electricity does what medicine, as usually prescribed, fails in doing.

In private practice, with appropriate medication, daily treatments, and auxiliary rest, the results are far more satisfactory. In acute states the recovery is quickly brought about. When relapses occur from imprudence the gain goes on again at the next sitting; when fresh symptoms develop they may each be relieved during the sitting without special prescribing, and it is this fact which constitutes one of the most gratifying features of the treatment of neurasthenias by static electricity. As soon as sleep improves through the aid of breeze and spray upon the upper spine and head, the whole system marches forward to a general improvement, for there is no restorer like refreshing sleep. The great nerve centres to which the physician is accustomed to address himself in central galvanization are equally important under static methods and the principles of affecting them are precisely the same.

Clinical Remarks.—From the fact that no removal of clothing is required and the patient derives an immediate benefit at every *séance*, static is preferable in practice to other forms of electricity in the treatment of neurasthenic patients.

The aim of intelligent treatment of neurasthenia with static currents is to make a sustaining, tonic impression upon the whole system. The methods involve general positive electrification and localized nutritional, alterative, function-regulating impressions upon the cranial and spinal centres and sympathetic system, and the motor-nerve supply of muscles, by the local concentration of current action upon the head, spine, and general surface of the body through the medium of the breeze and spark electrodes.

In these cases, as in all others, the physician must know his

electro-therapeutic target and how to aim at its centre. It will not do simply to apply in a mechanical manner "as directed" a breeze or spark or any other form of electrical energy.

It is essential to determine what effects are required, know how to produce these effects, and proceed with definite and positively applied methods to "round up" the errant nerve forces and reform their shattered ranks. They must be coerced into line and drilled again into effective action, and no perfunctory requests on the part of the operator will ever equal in result the effect of sharp and decisive commands. If anything is to be expected of static electricity in cases that have perhaps already gone the rounds of the neighborhood profession without relief, the operator must produce his results as Turner mixed his colors: "with brains, sir!"—for the Holtz machine will do little for a patient automatically.

It is necessary to say this plainly because an opinion prevails in some quarters that any electric current can be injected into the body in any sort of way, and either cure disease by accident like magic, or in other cases prove to be no good at all. Static electricity, within its legitimate sphere of action (see chapter on its physiology) will do what the skill of the operator makes it do, and seldom any more.

It is usually necessary to call a halt to further waste of nervous substance, aid the elimination of toxic products of fatigue and incomplete metabolism, and establish and maintain the highest possible nutritive activity.

To accomplish these things brief and infrequent treatment is disappointing. The nutritional and nerve-refreshing banquets of electrical energy must be fed to the nerve centres and the asthenic tissues to the extent of a "saturated solution" at each meal; and repeated often enough to maintain each nutritive gain, add to it, and put benefit upon benefit, on the same principle that food nourishment is forced in cases of emaciation.

It is certain that when the intervals between electrical doses are so long that the first benefit overpasses its maximum and

dies completely away before the second is administered, that the patient will stay very near the starting-point and make but slow advances toward the distant goal of health.

The state of nervous prostration may be due either to swift or gradual exhaustion, worry, starvation, or toxæmia of the nerve centres, but, however caused, I believe that the joint use of galvanic and static methods, together with sensible hygiene and accessory medication, constitutes the best-known treatment of neurasthenic patients.

The rest cure and massage are popular methods of treatment for neurasthenia, but the patient is indeed unfortunate who misses static electricity. Properly managed it is from fifty to five hundred per cent more satisfactory than routine treatment without it.

Neurasthenia has been said to constitute "a whole family of functional disorders." It is also said to be "at once the most frequent, most interesting, and most neglected disease of modern times." It may also be stated that static electricity, with the help of reasonable medication if not quite single-handed, will cure every curable case, provided the patient will submit to regular and systematic treatment.

The study of "nervous prostration" or "nervous exhaustion," "nervous debility," "weakness," "nervous dyspepsia," or neurasthenia under any of its many names is essentially a study of symptoms which are of the nature of functional derangements.

The characteristic effects of static electricity in the regulation of perverted functions are well known to all who employ it. The late George M. Beard presented a comprehensive list of the symptoms of neurasthenia in his work upon the subject of nervous exhaustion. It is impossible to peruse this familiar list without a profound appreciation of the single remedy which will conquer almost every one of Beard's hundred and fifty symptoms and give comfort to the afflicted patient.

No detailed instruction for the treatment of each symptom of neurasthenia can be required by the physician who studies

this book as a whole, for the general principles of treatment are carefully laid down. It is eminently suggestive, however, to group before the eye these collected symptoms of "the most frequent of modern diseases" so that we may know exactly what the static machine is capable of doing for its relief.

This remarkable list is as follows:

Symptoms of Nervous Exhaustion (Beard).—Tenderness of the scalp; cerebral irritation; dilated pupils; sick headache and various forms of head pain; pain, pressure, and heaviness in the head.

Changes in the expression of the eye; congestion of the conjunctiva; disturbances of the nerves of special sense; neurasthenic asthenopia; muscæ volitantes.

Noises in the ears; atonic voice; deficient mental control; mental irritability; hopelessness; morbid fears; astraphobia, or fear of lightning; topophobia, or fear of places; agoraphobia, or fear of open places; claustrophobia, or fear of closed places; anthropophobia, or fear of society; monophobia, or fear of being alone; phobophobia, or fear of fears; mysophobia, or fear of contamination; pantaphobia, or fear of everything.

Flushing and fidgetiness; frequent blushing; sleeplessness; bad dreams; insomnia; drowsiness; tenderness of the teeth and gums; nervous dyspepsia (dyspepsia asthénique); deficient thirst and capacity of assimilating fluids; desire for stimulants and narcotics.

Dryness of the skin; abnormalities of the secretions; abnormal dryness of the skin, joints, and mucous membranes; sweating hands and feet with redness (palmar hyperidrosis); salivation; tenderness of the spine (spinal irritation) and of the whole body (general hyperidrosis); coccyodynia; peculiarities of pain in the back.

Heaviness of the loin and limbs; shooting pains simulating those of ataxy; podalgia (pain in the feet); tremulous or variable pulse and palpitation of the heart (irritable heart); local spasms of muscles (tremors).

Dysphagia (difficulty in swallowing); convulsive movements, especially on going to sleep; cramps; sensitiveness to weather; sensitiveness to cold or hot water; sensitiveness to changes in the weather.

Localized peripheral numbness and hyperæsthesia; a feeling of profound exhaustion unaccompanied by positive pain; ticklishness; vague pains and flying neuralgias.

General or local itching (pruritus); general and local chills and flashes of heat; cold feet and hands; nervous chills; sudden giving way of general or special functions; temporary paralysis; diseases of men (involuntary emissions, partial or complete impotence, irritability of the prostatic urethra); diseases of women. Oxalates, urates, phosphates, and spermatozoa in the urine. Gaping and yawning; rapid decay and irregularities of the teeth.

CHAPTER XVIII.

CHRONIC FUNCTIONAL NERVOUS DISEASES.

Principles of treatment with static electricity. Frequency of sittings. Temporary functional nervous derangements. Methods of treatment. Acute chorea of children. Clinical methods of treatment. Results. Limited chorea of a part. Treatment. Chronic chorea in adults. The value of static electricity in treatment of the patient. Indications defined. A clinical case illustrating each leading type. A consideration of different static methods. The static cage in chorea. The static breeze in chorea. Sedative-tonic general electrification. Mild sparks. Auxiliary medication.

THE general principle of "treating the patient rather than the disease" should be followed in these cases, and efforts are to be made in the direction of "aiding nature to restore the sound state."

Depend upon general positive electrification for its sedative-tonic effect; upon the breeze, spray, and mild spark to relieve local symptoms, especially pains, aches, and muscular debility; and adjust the methods employed to the individual needs of the patient.

No rule can be laid down in advance. Daily repetitions are always advisable at first if they can be arranged. It is fatal to good results to allow too long an interval between treatments, for the benefit of the first will then be often entirely dissipated before the second is given.

It is the aim in all static electro-therapeutics to accumulate benefit upon benefit instead of wasting repeated sittings by delays between them.

Temporary Functional Nervous Derangements.—Many of these will obtain speedy relief from some form of static application adapted to the symptomatic manifestations, without reference to the apparent cause. The basis of treatment in

this class of cases is the function-regulating, sedative-tonic action of positive polar general electrification, upon which must be engrafted such local uses of the breeze, spray, or spark as may be required to meet the indications.

In all these cases we must treat the general health of the patient, and it is impossible to direct special methods in advance of seeing the case. References to diseased conditions by the terms of classical nosology are not very helpful. If the operator is informed as to the effects his different methods will produce and knows how to administer them with judicious dose-regulation, he will be fully prepared with static electricity to meet and relieve a great many manifestations of the functional neuroses.

Acute Chorea of Children.—Static electricity treats the patient by way of aiding nature to restore the nervous equilibrium.

Administer simple positive electrification for fifteen minutes at first. As soon as the child is free from alarm and will accept all the operator wishes to do, shorten the general treatment by one-half and devote the second part of the sitting to a concentrated positive breeze over the entire head and spine, with particular impression upon the centres of the medulla and cerebellum.

To this may be added shortly, and later substituted for it, an application of mild positive sparks to the cervical and lumbar spine—and ovarian region in front if the patient is a girl. Do not agitate the already overactive muscles by sparking the arms.

Repeat daily until the nervous system remains tranquillized for a longer interval, and then every second or third day as may be indicated.

The average results of medical treatment of chorea will be made more certain, more quickly attained by probably one-half, with an early and immense relief to the patient's nerve tension, and decided improvement in general health, when static elec-

tricity is employed in conjunction with the use of indicated mild remedies.

It is efficient in some cases alone, and when rheumatism complicates the chorea it is more than ever indicated, and should be employed in every case with an intelligent adaptation of the method to the state of the patient.

If there is marked brain disturbance the best primary application is negative electrification with positive head breeze. The habit of pushing Fowler's solution of arsenic to the border line of poisoning the patient for the sake of combating chorea is an extremely poor one from the standpoint of rational therapeutics, and is left without excuse when the resources of static electricity are employed.

In the very small proportion of cases in which it fails to make a decided impression upon the spasmodic symptom, its influence for good upon the nutritive processes, pelvic functions, and upon the cerebro-spinal nervous system in general indicates its aid as one of the best and most grateful helps the patient can receive.

That there are some causes at work in the production of exceptional cases of chorea which render them practically incurable is self-evident, and it is not necessary to explain that electricity will not cure all cases of chorea.

In persistent, localized chorea of a limited part, the nervous state is usually so below par that static electricity may well be employed even if no hopeful prognosis for relief of the chorea can be given.

It will improve the strength, composure, confidence, and spirits of the child, and in this way, if in no other, will be beneficial to the extent of perhaps one-half the value of a radical cure.

In partial choreic affections from chronic spinal disease the spasmodic movements cannot be made normal, but the patient can nevertheless be given so much comfort and relief from various symptoms—pain, irritability, morbid mental states, etc.

—together with added strength to the arm or part affected, as to express decided satisfaction even when the physician will note that the so-called chorea is nearly as bad as ever. It may be, but the patient is better, and is often inexpressibly grateful to static electricity for the measure of relief afforded by it.

Chronic Chorea in Adults.—Static electricity is by no means without practical value in cases of chronic and incurable chorea in adults, nor is it difficult to say in advance what benefits the patient may expect.

The indications for various forms of electricity are by no means mere guesswork, but are accurately outlined in the ascertained facts of electro-physiology, and quickly attain even more accuracy than do the indications for most drugs under the instruction of educated experience.

If the patient is muscular, strong, well nourished, with good appetite and digestion, and practically without symptomatic disturbances except the spasmodic movements, do not expect any material benefit from static electricity. I do not undertake such a case except at the patient's urgent request, and with the understanding that the treatment is purely experimental and little or no results are to be expected. This class of cases is in the minority.

If the patient is at the antipodes of the electro-positive state of general health, is negative, anæmic, neurasthenic, the whole muscular and nervous system debilitated, with broken sleep, headaches, spinal and muscular pains, and other symptoms which are much more frequently met in these cases than otherwise, static electricity will do good in direct proportion to the degree of the negative state. For a full explanation of the *rationale* of the effects of static electricity in benefiting these patients, the reader who has been referring them to chance is referred to the chapter in this book upon the physiological action of static currents.

On September 9th, 1893, I reported the following case which exemplifies the above remarks:

Miss ——, chronic chorea of forty-four years' duration. This interesting case had its origin in a fright when the patient was six years of age. She is now 50, single. Weight, 105 pounds; extremely nervous, head and right arm affected; head would play a tattoo on the pillow half the night before she could compose it for sleep. Arm nearly powerless. No appetite, dreaded the observation of strangers, and lived a secluded life. Had constant pains in occipital, cervical, and lumbar regions.

After one month, during which she had only ten treatments, she reports: "Owing to illness in the household, I have had to assume duties much beyond my strength, so that I have been unable to do justice to my own health. I have, however, gained three pounds, sleep composedly, am hungry for every meal, go out alone freely, do not mind the gaze of strangers, am less nervous, can use my arm for many little services, can stoop and pick up an object from the floor, a thing I never did, in my recollection, until now.

"I have had no pain in my head and back since the second week of treatment, and the constant sense of nerve strain which I formerly had is entirely gone, so that I have more comfortable rest than at any previous period of my life."

During the three and a half years which have since elapsed I have kept track of this case. She has been under an unremitting strain of domestic cares, and has been and still is in great need of much further treatment. Once in a while she has come to me for quick relief from some temporary symptom which she has learned from experience that a single static administration will abolish, but she is not so circumstanced that she is able to attend to her own health in a proper manner. She, however, has stated to me over and over again that she has never lost the original improvement, that but for the benefits derived from the static applications she could not have endured the subsequent tax upon her, that the distressing pain in the cervical spine from which she suffered for many years has never returned except for brief intervals when she was extremely fatigued, and she often expresses her gratitude for her general increase of comfort and strength.

Another phase of chorea in its chronic and practically incurable form is illustrated in the case of J. D.:

J. D——, October 5th, 1896, aged 35, porter by occupation. Chorea began in early childhood following scarlet fever, affects both upper extremities and head. Is a hardy, muscular man of medium weight, and when sitting with his hands grasped together, controls the movements to rest his arms by pressing them between his knees.

Owing to the fact that practically no improvement in his nutrition, digestion, sleep, and muscular strength was needed, and that he had no pain or other symptoms except the spasmodic movements of the head and arms, he was told that his condition was not favorable for treatment. He, however, expressed an earnest wish to "try electricity," and he was accordingly given eight administrations between October 5th and October 23d. No change in the state of the chorea took place, and although the patient desired to continue the treatment for at least three months in order, as he said, to thoroughly satisfy himself, I considered the indications very clear and declined further treatment.

In choreic movements associated with spastic paralysis of an arm, with atrophy and tonic contraction of the hand and wrist muscles, the prognosis from electrical treatment can only refer to improving the general health and local nutrition and strength. The chief symptoms will remain about the same except so far as they are ameliorated by the processes of nature. The treatment of such a case was begun September 9th, 1896.

E. R——, aged 14½, right foot, leg, hand, and arm affected, also neck and head in a less degree; the muscles of speech are affected, but he can talk so as to be understood. Duration of disease, four years. The boy was anæmic, exceedingly nervous, and startled by almost everything going on around him. He was fairly strong and of fair size for his years. He was regarded as incurable, and his mother who brought him for treatment was so informed; but as she expressed a wish to do everything that could possibly be done for her child and leave nothing untried that might be of benefit, treatment was undertaken with no promise as to the results.

Between September 16th and December 4th he received thirty-two applications by various methods as they were in turn indicated.

At the third visit he reported that he felt improved, less nervous, slept better, was not frightened so easily, and that he had

picked up a lead pencil from the floor with his paralyzed hand, which he had previously not been able to do.

While an observer could detect no anatomical change in the condition of the wasted and spastic muscles or the contracture of the knee-joint, yet the boy persistently stated that the treatment was doing him good, and his mother said that he was so eager to come that nothing would induce him to miss a single treatment. He had, however, an acute attack of tonsillitis and did not attend for two weeks.

On November 16th and 23d entries were made in my case record as follows: "Has grown steadily stronger, is less nervous, has a good, hearty color, and although arm and leg are but slightly improved, his general state of health is remarkably improved; he has grown into a stout, rugged boy, and feels greatly benefited."

The manner in which this boy began to grow and change in spirits while he was treated with static electricity excited frequent comment among physicians and others who observed the case.

Case reported by Dr. F. A. Kraft, Milwaukee, Wis.:

Chorea.—A girl, 13 years of age, presented herself at the office with a very marked case of chorea; her speech was an incoherent mumble. I examined her closely, but did not find any cause that could have produced her condition. Gave remedies like arsenic, gelsemium, etc., but with no results. The second week I applied the static current, particularly upon the spinal region. An astonishing effect was also derived from the static head breeze, which seemed to have a direct antidoting effect against the disease. Immediately after the treatment a desire for sleep manifested itself, and after having enjoyed this blessing of nature for a few hours the patient awoke refreshed. After eleven treatments she was discharged.

Her older sister had chorea two years ago and was treated for twelve months by other methods.

Chorea has been successfully treated by different physicians by different methods of employing static electricity. Bishop has employed the static cage with much satisfaction and cites the following case:

A young lady who was sent home from a seminary in consequence of a severe chorea minor, complicating chlorosis. She

was placed in the static cage and given the shower bath ten minutes.

During this time she was made to inhale deeply and regularly the electrified atmosphere which surrounded her. The poles were then approximated and the oscillating current, as strong as she could comfortably stand, was given for ten minutes. At the end of the treatment she would invariably come out of the cage with rosy cheeks. At the end of three weeks her menstrual function was re-established, the chorea was gone, the chlorosis had disappeared, and she went away feeling well and happy. This case was treated daily.

The static cage, as described by me elsewhere, is simply an expansion of the static breeze, and Brower reports his experience with the ordinary form of breeze in the following language:

The patient is placed upon the insulating platform connected with the positive pole. The head-breeze electrode is connected with the opposite pole. The total treatment consists of ten minutes' simple positive electrification with five minutes' head breeze, after which the patient rests in the reception-room for about ten minutes. Treatments are repeated if possible every day for the first week, then three times for the second week, and two treatments thereafter until the case is relieved.

All of the eighty-eight treated (by Brower) were also placed under the best possible hygienic conditions. Eighty-three of the cases had a duration of disease averaging from twelve to eighteen weeks and had resisted the treatment of the family physician, and were subjected to static electricity because the physician, or parents, or both were discouraged with the effects of other remedies.

When necessary school was stopped, an hour of rest required in a darkened room at midday, the diet carefully regulated, and elimination by the bowels, skin, and kidneys maintained at a proper standard.

Arsenic in some form and in varying doses was administered to all. In the most rebellious cases it was pushed to the limit. Blaud's pills were given in anæmia. If the patient was a female and puberty was delayed, cimicifuga was administered for its tonic properties on the uterus. If the patient had a rheumatic history, sodium salicylate, or more recently salophen, was made a part of the treatment.

If the sleep was insufficient, bromide of sodium, with or without chloral, was administered at bed-time.

Fifty-three of the cases were females, thirty-five males. Ages ranged from six years to thirty years.

Five of the cases only were acute and had continued less than one month.

The immediate effect of the treatment on these patients was often magical. Just as soon as they became completely charged on the platform, the violent contortions would stop and the patients remain quiet as long as the treatment was continued.

Forty-five per cent of all the cases treated were relieved in about six weeks. The more chronic the case the longer the treatment was necessary. I have just completed the successful treatment of a case in which the disease had continued uninfluenced by all other treatment for two years. The static treatment was five and one-half months.

It is, however, superfluous to attempt to add much to the classical reports upon the treatment of chorea by static electricity which are contained in the latter part of this book. Every physician should study them in detail and profit by the sound remarks which accompany them. The modern machine supplies something of the deficiencies which surrounded the methods employed half a century ago, and we now expect not only better results but very much greater help in improving the constitutional state of the patient than was possible when Leyden-jar discharges were the chief means employed.

CHAPTER XIX.

STATIC ELECTRICITY IN HYSTERIA.

Its action as a function regulator. Its influence upon the sympathetic nervous system. Three indications for static electricity in hysteria. The management of hysterical patients during treatment. Operative methods. Spinal irritation and hysterical spine. Static methods of treatment. Clinical remarks and clinical precautions.

THE treatment of protean hysteria will enlist the full resources of the physician, but if electricity is employed symptomatic medication can many times be set aside. Hygiene and mental therapeutics may be utilized as far as they will go, but electricity should be added to them, and it constitutes a sheet-anchor among curative measures.

The ordinary and most frequently advised, yet most troublesome and least effective method of electrical treatment consists in "central galvanization and general faradization on alternate days, with local faradic exercise of any paralyzed muscles. If improvement progresses in a short time the *séances* may be reduced to three times a week. In some cases a course of two weeks' treatment will reinforce the nerve centres for six months or more before a relapse occurs. Then treat again."

In patients confined to the house for any reason, the electrical applications can of course be made only with portable batteries; but for persons that can or will come to the office, the static machine surpasses in value all other resources of therapeutics. There is no doubt of this.

Hysteria is a functional disease of the nervous system, characterized by a morbid susceptibility to mental emotions without will-power sufficient to control them. It also involves sympathetic nervous phenomena. There is frequently some un-

doubted relation between hysteria and uterine and ovarian disturbances. Violent mental phenomena arising from grief, disappointment, anger, fright, suspense, etc., are also among factors of causation.

These familiar facts in regard to hysteria are known to everybody, and the physician who will turn from them to a careful examination of the actions of different administrations of static electricity upon the nervous, circulatory, and muscular systems will find that it is a remedy which fits the disease as completely as mercury fits syphilis or quinine malaria.

Some of the directions for the management, control, and treatment of hysterical patients perpetuated in general works on medicine are unnecessary and unkind, and if literally followed would not be calculated to maintain further cordial relations between the physician and patient. Valerian and asafœtida are also ill-smelling stuffs to have in the house, and alcohol and opium, chloral, sulphonal, chloroform, etc., lead the patient down hill instead of up. Removal of innocent ovaries has time and again proved to be a vain procedure, and hysterical patients in general form a class who seem to have few rights that medical authors feel bound to respect. A cold bath administered in hospital cases is sometimes disastrous.

There are three indications for static electricity: (1) The improvement of the patient's general health; (2) the relief of symptoms; (3) a more or less permanent cure.

The management of an hysterical man or woman upon the platform of a powerful and well-handled static machine cannot be set forth in book form, and the secret of satisfactory results lies in a tactful controlling management of the patient rather than in set rules of treating the disease.

The static machine reduces the successful treatment of hysteria to practical lines, and no kaleidoscopic changes of symptoms in these cases can ever embarrass the therapeutist for a remedy, nor elude the searching out of some conquering breeze, spray, or spark from this versatile master of neurotics.

In genuine cases of hysteria with paralysis, aphonia, ovarian pains, backaches, joint pains, curious sensations, and all the vagaries which this neurosis may present, static electricity is the sheet-anchor.

The basis of treatment is a most thorough constitutional application of positive charge for eight or ten minutes, or potential alternation in suitable cases, together with head and spine localizations of the positive breeze or spray; and later when required positive sparks to the spine, affected muscle groups, painful nerves, hysterical joints, the lumbar and ovarian region in women, and the lumbar centres and perineum in men.

Some of these patients complain of one form of application while they welcome another, and their feelings should be regarded; but as they sleep better, grow brighter in spirits, experience less irritability, and yield to the gradual influence of the sedative-tonic static current, they usually become eager for it and are convinced of the benefit it imparts. If a patient's mind occasionally takes the opposite view, the treatment should not be urged.

Spinal Irritation and Hysterical Spine.—Seat the patient comfortably upon the static platform with the positive pole connected to it. Ground the negative pole and administer simple sedative electrification for about ten minutes. Then ground the brass point electrode and administer a soothing agreeable breeze up and down the spine and upon the head by long sweeps of the electrode.

At tender spinal points concentrate the breeze into a warming and anodyne spray, and, if it is possible to cause any aggravation by movement or posture, have the patient do so and persist till the pain is gone.

As soon as confidence is established, encourage the patient to accept mild sparks over the spine and lower extremities, and also the ovarian region if symptoms indicate. Repeat daily if possible, and a few sittings will usually complete the relief.

Clinical Remarks.—Static electricity especially commends

itself to hysterical patients, both by reason of its beneficial effects and the facility of its administration without removal of clothing. Some tact is, however, required in the management of electrodes for local applications until the confidence of the patient is established by the benefit obtained. A patient in an extremely unsettled state will often regain a degree of composure after ten minutes on the platform which she would not have believed possible before she experienced it.

It is at the first visit and during the first treatment that caution is required, for if a patient is pleased and benefited the treatment will go on agreeably, while if careless or rudely performed applications are abruptly made, the second visit may never come.

A word of assurance to the patient and a gentle manner is always advisable. The very gradual approach of an electrode which the patient sees for the first time is very much more judicious than the startling effect of a sudden spray or spark, which the patient does not understand and for which she is not prepared.

Managed in a sensible way a preliminary sedative electrification will prepare the nervous system for a local breeze, the breeze will pave the way to the stronger spray, and the spray will prepare the tissues for mild sparks. When mild sparks are applied with comfort to the patient there is no further difficulty in increasing their vigor if there is any temporary need at any time of a few long and powerful sparks.

CHAPTER XX.

PAIN.

Varieties of pain relieved by static electricity. Its advantage over injurious drug anodynes in chronic pains. Its nutritional benefits. Sphere of action of static electricity as a pain reliever. How different methods of application affect rate of current flow. Limitations of current action within pathological tissues. The anodyne effects of the static breeze and its modifications. Indications for the breeze defined. Indications for sparks in painful states. Character of pains relieved by sparks. Leyden-jar currents applied to painful tissues. General and local sedation. Acute congestions and inflammations.

In the consideration of any of the single symptoms of disease pain will be accorded the chief place of importance, by the invalid at least, if not always by the physician. One writer divides pain into six different forms as follows:

Pain due to inflammation.

Pain due to pressure.

Pain due to stretching.

Neuralgic pains.

Subjective pains.

Cutaneous pains.

This classification presents little clinical usefulness, but the patient will generally desire curative relief from pain when it can be obtained, and palliative relief when nothing better is possible.

For the relief of pain occurring without evident diagnosis of the cause, or when not affected by treatment of the cause, or when the cause is removed and the pain persists, or when the condition is incurable, the resources of medical electricity are many and various. No exact directions can be given in advance to cover all cases, but the conditions of each case pre-

sented to the practical physician will suggest the method most likely to relieve, and if one method fails another may be tried. The skill which comes with experience will usually select intuitively the most successful form of application.

Whenever any form of electricity will palliate any incurable pain it possesses the enormous advantage over morphine, antipyrin, and other drug anodynes that at the same time it is giving temporary relief it is also imparting a general nutritional benefit.

In other cases of chronic pains in which the anodyne action of drugs most commonly employed is not only non-curative but ultimately harmful to the patient, the fact that some form of electrical current—galvanic, faradic, or static—may be administered with both curative and tonic effects is a decisive argument in its favor. The study of the control of pain is one of the most interesting in electro-therapeutics.

Static electricity is a great pain-reliever. It will temporarily comfort almost any pain that can attack the living tissues, but its curative efforts relate to pains of well-understood character. It will rarely stretch beyond its own indication and permanently cure a pain to which it is not suited. When it fails the galvanic current is often indicated. When these, singly or together, fail to cure pain, and in common with all other measures prove to give but temporary relief (as often in locomotor ataxia and cancer), they are blessed palliatives to the patient, for, unlike drug pain-destroyers which also destroy vitality, electrical currents build up the forces of nutrition.

The great sphere of static electricity by insulating methods relates to the nervous, circulatory, and muscular systems. It is not well suited to pains within bones, cartilage, deep viscera, and between articulating surfaces. It must act upon tissues within which it can exert its limited effects, and a careful consideration of the action of static electricity in painful affections will repay every student of the materia medica.

In its form of general positive electrification it very often

corrects those general, undefined, and mild expressions of pain which accompany slight constitutional disturbances.

It evidently does this through its tendency to regulate functional processes, to disturb disorderly atoms and rearrange them in better order, and to "assist nature to restore the sound state." It summons together the broken ranks of the nerve forces and influences them to march all one way; but it does not always succeed in holding them together permanently by one dose of ten minutes when reactionary forces are obstinately established. Therefore a repetition of treatment is required.

There is an old experiment which shows that when tadpoles are swimming about in a basin of water and a galvanic current is passed through the fluid, the tadpoles instinctively fall into line and swim agreeably in the direction of the current flow. I believe that some influence similar in character is exerted upon the ultimate particles of the protoplasm of the human body during the passage of an electrical current, and that the tendency of static electricity to regulate to normal action all varieties of functional derangements is explained in this way.

The energy of current action is dependent on the *rate of change*. This rate is greater with what is called a large dose than with a so-called mild dose; it is greater in any part through which the current is localized than it is through the same part when the application is general, and it is greatly increased when the localization ceases to be convective merely, and becomes disruptive.

Students of galvanic electricity will remember that the ampère is the unit of the rate of galvanic current flow, and that the number of milliampères obtained as a medical dose in proportion to the effect desired expresses simply the rate of current flowing through the tissues. The dose increase therefore of ten, twenty, fifty, or a hundred milliampères indicates the increase of intensity of action through an increase in rate of motion. Rate of movement is an equally important factor in the

practical work accomplished by all currents of water, air, or electricity.

In static electricity the *rate* is still the all-important element in therapeutic work, although not one physician in perhaps a thousand has ever had his attention directed to this rudimentary fact.

It is for this reason that large Holtz machines are more efficient than smaller ones. In administrations of a powerful static current the rate of change is least when the discharge from the insulated patient is restricted to general diffusion into the atmosphere, but every form of local application has the effect of quickening the rate of change through the powerful attraction of an opposite potential force.

The static breeze upon the head or spine is simply an immensely quickened rate of electrical change through the tissues in near relation to the discharging electrode, and consequently it increases the work done in the tissues upon the same principle that an increase in the rate of flow over a waterwheel will increase the amount of work done in the mill which it affects.

The limitations of the character of the physiological work done by static electricity are well known. It does not attack connective-tissue new formation or structural changes; it does not perform chemical electrolysis, or reorganize living tissue from the ashes of the tomb; it does not destroy specific disease germs, nor does it exert a marked influence upon the inorganic matter of bones; but acting as it does in its own way as set forth in the chapter describing its known properties, it is one of the most certain, definite, and effective remedies known to the materia medica.

The anodyne effects of the static breeze are not produced by local anæsthesia. They do not benumb. They act, so far as they are either temporary, or become permanent by repeated doses, by changing disordered sensation into orderly and normal sensation.

The static spray goes a step beyond this because it adds still more intensity to the rate of change and the local concentration.

Sparks go beyond the spray, for they bring the rate of change, however rapid it may have previously been, to an instanteous climax of wellnigh inconceivable rapidity by a complete disruptive discharge. They therefore abolish pains that refuse to budge for the coaxing of simpler methods.

If a patient who is positively charged will hold out a finger toward the negative prime conductor and attract a single long spark, he will find that it benumbs and dulls the sensation of the nerve filaments of a healthy finger-tip. When a number of such sparks are applied to a painful part they not only intensify the rate of change, and thus produce a maximum of physiological effect which is dependent upon rate, but they temporarily benumb the sensory nerve filaments wherever they strike a blow. The capabilities, therefore, of static electricity in relieving pains through the agency of modifying or increasing the rate of change cover a wide range of clinical practice; and when we add to these capabilities of the breeze, spray, and spark the mechanical effects of Leyden-jar currents, which cover the whole range of external applications of faradic currents, we must accord to static electricity the most diversified usefulness of any single agent in therapeutics.

The Breeze and Its Modifications.—Applied with proper reference to polarity and the seat of pain, the static breeze will relieve at once, and gradually cure, headaches not due to a persistent cause elsewhere, or a tumor, or condition within the head which external treatment will not reach—such, for instance, as the pain of a middle-ear abscess.

In headaches of nervous and circulatory irregularities, anæmia, congestion, insomnia, anxiety, overwork, menstruation, study, rheumatism, gout, neuralgia, cold, general debility, cerebral neurasthenia, and reflex headaches that linger after their cause has been removed, and cases of allied nature, the satis-

factory relief it speedily affords at the first application becomes permanent nearly always after sufficient treatment.

When disordered functionation manifests itself by sore and bruised feelings in the soft parts, the positive static breeze concentrated to almost a spray restores the normal circulatory state and produces comfort.

The static breeze relieves the headache of cachexias for periods varying from a few hours to several days after a *séance*, and is thus a useful adjunct to medication.

It does not cure specific pains; it will not give satisfactory relief to bilious headaches until the gastric disturbance is corrected; it may fail or succeed in severe neuralgias about the head; and every once in a while a patient will appear with a stubborn headache which baffles alike a satisfactory diagnosis and satisfactory treatment.

The head pains treated by the static breeze must be properly selected, but when this is done the remedy is very efficient.

The static breeze also relieves the pains of dermatitis, bruises, sprains, the soreness of excessive muscular fatigue and strains, local aching conditions in muscles, neuralgias near small joints or bony structures covered with little muscle, acute congestions and local or glandular inflammations, the pains of a bunion, a toothache, and the sore bruised gums left by the dentist after he has either filled teeth or pulled them out.

Acute pains due to conditions which require gentle and soothing comfort are best treated by the static breeze.

Painful chronic states which are best treated by counter-irritation or muscle stimulation are well treated by either the concentration of the negative breeze into a strong spray or by short friction sparks.

Sparks.—When the character of the pain denotes that something in the tissues needs forcible driving out, the spark is called for and the breeze is inadequate.

The particular pains relieved by static sparks are localized within muscles, fascia, and nerve sheaths.

The spark is of immense value for painful conditions below the neck, but it is not suited to pains caused by the distortion of nerve filaments within contracting cicatricial tissue or a bone callus; or pains of deep visceral neuralgia, of acute congestions and inflammations, and pains deep within joints and bones, due to diseases of the bones.

In some cases the character of the pain comes within the action of the spark, but the site of the pain is in such relation to sensitive tissues to which the spark could not be applied with comfort, that we adopt other methods by preference.

The great sphere of spark action is upon and within muscles. When exudation pressure, or the circulation in the system of irritants, such as an excess of uric or lactic acid, or the products of waste, set up pain, the spark is indicated, as well as in almost all cases of chronic inflammations, congestions, and neuralgias. The spark can usually be modified in force with a little operative skill to fit the part and to fit the pain, and will control a great variety of reflex, functional, and neurotic symptoms of a painful character.

In all the large class of pains which are called rheumatic the spark is *facile princeps*, especially when there is chronic inflammatory exudation locked up in unyielding muscular fascia and nerve sheaths. The strong spark will cause this exudation to move on and out by a process very similar to the principle of the circulation of blood in the veins and the circulation in lymph vessels.

Leyden-Jar Currents.—These static currents applied with moist electrodes in contact with the body relieve pains to which the faradic currents from high-tension induction coils are also suited and are usually employed.

These pains are chiefly of the muscular character which the spark also relieves, but the high potential small-jar current oscillating with extreme rapidity will also act upon pains deep within joints, between articulating surfaces, in the trunk of the

body, and the acute localized congestions, bruises, burns, etc., which the breeze benefits.

An ordinary sponge-covered electrode moistened with hot water is placed directly over the site of pain and connected wtih the positive Leyden jar. A similar electrode connected with the negative jar is placed so that the current will pass directly through the tissues affected with pain. The sliding poles of the machine are then brought together till they touch, and when the machine is started into rapid action the dose is regulated by pulling the poles a little apart until the current strength produces sedative relief without passing beyond the point of comfortable tolerance.

As these applications require the removal of clothing upon the main portions of the body, they yield in practical importance to the more commonly used methods.

CHAPTER XXI.

BRAIN-FAG AND INSOMNIA.

Brain-fag, acute or chronic. Refreshing effects of static electricity. Technique of methods of treatment. Value of static electrification to professional brain-workers. Chronic cerebral exhaustion. Indications for static electricity. Static electricity the reverse of a mere stimulant. Its great nutritional benefits. Their permanency. Static electricity the chief agent in the treatment of states of mental exhaustion. Acute neurasthenic insomnia. Clinical illustrations. Historical examples. Suggestions for practical treatment of desperate cases. Chronic insomnias. Importance of improving nutrition. Successful treatment by electric currents. Four chief methods. The technique of static treatment. Prognosis. Cases to which static electricity is not suited.

WHENEVER overwork, mind strain, worry, literary labor, the competitions of business men, the anxieties of the physician, of a lawyer over the preparation of a case, of politicians in an exciting campaign, the tax society women undergo, or the monotonous routine of school-teaching, sets up an exhausted state of mind, there are two reparative and essential necessities—restorative nutrition and sleep. Static electricity promotes both of these.

Its immediate sedative-tonic effect is exceedingly refreshing to jaded nerves. When the restless mind refuses to obey the will and voluntarily to rest, this potent function-regulating force seizes upon the irritable and exhausted nerve cells and quiets them into the needed state of composure. The "fidgets" and fatigue disappear, and nature is given an opportunity to resume her tranquil and normal workings.

If the physician so desires he can disrobe the patient and employ the small Leyden-jar current with a negative foot-plate, passing a positive sponge electrode in turn over the surface of the body as in general faradization, which this method

reproduces. This imparts a feeling of lightness, buoyancy, and mental and physical refreshment that no drug sedative or tonic can approach. The patient is ready to seek a couch and enjoy a comfortable nap immediately after the *séance.*

The quicker method, which is practically superior to the other because it requires no removal of clothing and takes much less time, consists of positive electrification, or potential alternation, for a sufficient time to rest the patient perceptibly, followed by a strong negative spray upon the entire spine and especially concentrated upon the cervical, cerebellar, and lumbar centres.

If vertex or frontal sedation is also indicated by the complaints of the patient, a fixed electrode can apply a positive head breeze for five minutes, or the author's form of frontal breeze with an interrupted current and positive electrification for a few moments.

If the muscular system is relaxed from want of exercise and by sedentary indoor occupation, the massage effects of mild positive sparks upon the principal groups of muscles will close the *séance* most effectively and impart a sense of renewed strength and exhilaration.

In acute brain-tire under the stress of a great but temporary task this application will either speedily restore rest at the end of toil, or, if applied daily during the tax of mind, will support the powers, offset nerve waste, clear out the clogging cells, and keep the forces at their highest working pitch. To many professional men during trying emergencies the static machine would be a welcome boon if they were made aware by physicians of its existence.

In chronic cases accompanied by anæmia and general neurasthenia the restful and nutritional action of electricity is more than ever indicated for the patient, but improvement will be much slower. If the applications of static electricity in chronic cases can be made daily for a few weeks and can be accompanied by reasonable rest, outdoor diversions, and suitable hygiene, the

juncture of such practical therapeutics will produce the happiest results.

Many a prominent and brain-fagged clergyman and business man would benefit by this simple method. I have in mind as I write these lines two notable instances of breakdowns in New York pulpits, with reports of unsettled reason, and an after history of long travel in search of rest and health with but half success. Faraday himself broke down from overwork and never fully recovered, although he spent two years in quiet retirement. To these cases static electricity is fitted with peculiar and gratifying efficiency. Active brain-workers in all fields of intellectual excitement and business competitions would do well to obtain a short course of static treatment two or three times a year in advance of any threatened breakdown, for an ounce of prevention is worth a pound of cure, and few cures are more tediously obtained than that from mental collapse.

It is, however, a common experience to find that these important citizens of our commonwealth, whose brains are in the highest degree valuable to themselves and the community, and who are most liable to brain-fag, invariably consult a practitioner whose knowledge of electricity is a combination of misinforming reading and practical ignorance. Some prejudice is frequently added in the physician's mind, so that he either advises the patient that he needs nothing but "rest," or audaciously advances the conspicuously false information that he is "too nervous already, and that as electricity is only a stimulant it would do him more harm than good." Some day, when all medical colleges teach in a thorough manner the simple facts of electro-physiology along with the general facts of drug physiology, physicians who figure as specialists, but who betray the ignorance of a tyro in an important branch of medicine, will find it necessary to comprehend the relation of electricity to the nervous system.

No class of patients exists who stand in more need of the decided advantages of proper electrification than the very ones

who are often prevented by wrong advice from seeking its aid.

It is often noticeable that consultants of the greatest prominence in handling these cases are unable to suggest any medication with much confidence, and adopt the habit of referring the invalid to "time and rest." Great injustice is done the patient in hundreds of cases by such advice, and as the study of electro-physiology is open to every inquiring physician, even though he may not possess any electrical apparatus of his own, there is no excuse for failing to give the invalid's shattered nervous system the benefit of every sedative tonic and restorative agency available in practical medicine. Among such agencies static electricity stands in the front rank.

Acute Neurasthenic Insomnia.—Every now and again some case of complete nervous bankruptcy comes prominently before the public by reason of the distinguished character of the victim.

The class of cases to which I refer will be understood by all who recall the sad end of one of the great trio of New York journalists of a generation ago. For a little more than a quarter of a century he ruled supreme in the affairs of the great newspaper he created; then suddenly the next act in the drama took place in an insane hospital. The stricken heart and overburdened mind had given way, sleep was denied the man exhausted by the labors of a fruitless campaign and by acute grief for one over whose last hours he had kept ceaseless vigil day and night for more than a week. After this came the great blow of a trusted friend's supposed perfidy, and nature yielded to the strain. His tragic death speedily followed. Could sleep have been procured he might have lived another score of years.

The greatest experimental electrician the world has ever seen broke down in the midst of his immortal and unrestrained labors in 1840. Scott did the same thing when he was giving to the world the last of the most original, prolific, and successful series of novels that ever emanated from a single brain.

The history of our own feverish age of professional, political, and commercial activities is filled with examples of mental wreckage—too often followed by the climax of uncontrollable insomnia, lingering misery, or death.

A striking case in point comes before me as this chapter undergoes preparation for the press. The account made public should fix a lesson upon the mind of every practical therapeutist, and for this purpose it is repeated here:

General ——, who has been prostrated for the past few days with a severe attack of neurasthenia, was no better this morning. The General complains for the past fortnight that he has had hardly any sleep, except what has been induced by occasional doses of morphine, which, however, his physician would not allow him to have often. "I spend the greater part of the night," said the General, "in walking up and down the floor here. I feel utterly worn out, and fear the worst consequences of my illness. The most distressing symptom is this horrible restlessness and insomnia. I also suffer from severe pains in the forehead, and I find that I cannot keep my attention fixed on a book or anything else for any length of time. I cannot describe the utter despondency I feel. My doctor advises me not to lie in bed all day, but go out for drives occasionally, which I sometimes force myself to do. He often advises me not to make myself miserable about my condition, but that is easily said."

The condition described is a trumpet call for static electricity.

It is my belief that the physician who withholds from such a patient in his extremity the best resource that medical science contains fails in his duty. If the physiological and therapeutic properties of action claimed for electrical currents when rightly administered are demonstrably true—as the writer believes and knows they are—physicians who continue to disregard or ignore clinical facts of such vital importance assume a moral responsibility for which there is no excuse or warrant, for ignorance is no excuse either in the eyes of the law or in medicine.

It is well known that it is within the power of electro-sedative-tonic applications in restless states to tranquillize the

central nervous system, equalize the circulation, and restore the restfulness that is temporarily lost to the control of the will. In acute cerebral exhaustion there is little will-power left to coerce the hyperexcitability into calm and sleep. "As well," said Sir Walter Scott to his doctor, "put a kettle of water on a red-hot stove and tell it not to boil as tell me to stop thinking."

Advice does these patients little good, nor are hypnotics and drug sedatives alone to be relied on. Both physical and mental nutrition must be restored, and cardiac depressants are not infrequently dangerous. The most urgent indication in nearly every such case is electro-tonic sedation. Every other resource of medical skill may indeed be employed, but electricity in suitable form is wellnigh indispensable.

It would be impracticable to attempt to set down rules for the treatment of this desperate insomnia, for no physician could in such a crisis depend upon book study. He must understand technique in advance, or he must turn over the case to some one already experienced in electro-therapeutics who can select and modify as needed the galvanic, high-tension induction coil, or static applications. A simple suggestion which may be safely inserted here would be to seat the patient on a static platform insulated negatively and apply a strong positive head breeze, spinal breeze, and tonic spray to the region of the medulla for a sufficient time to produce a marked impression upon the great nerve centres. This would require perhaps ten minutes. Then in a reclining-chair with simple positive electrification leave the sufferer in the quiet of a somewhat darkened room with a watchful but silent attendant.

If the plates are revolved by an electric motor an hour may go by in the undisturbed repose and probable sleep of this exceedingly restful and restorative administration. It can certainly do no harm; it can be repeated once, twice, or even three times a day until the crisis is passed; it can be modified by the expert to meet every emergency of the patient's functional condition; it can be supplemented by local applications and by

any and all other remedial measures, and it will conflict with none. It is certainly a duty to point out to physicians the immense value of this agent (static electricity) when exhausted nature demands sleep as the condition on which health depends. Those who ignore the facts of electrical sedation do so against the best interests of their patients. Potential alternation would also be an admirable method.

Chronic Insomnias.—Various forms of electricity indirectly improve sleep by relieving symptoms upon which wakefulness has depended, and by regulating functions and promoting nutrition in general.

It is one of the common observations of clinical experience that improved sleep is one of the first signs of benefit even when the application is local and to parts distant from the head. This is true of all currents and of the most diverse variety of methods of technique and dosage. No electrical application is a direct and forcible sleep-compeller, but no narcotic or active hypnotic equals in kind and degree the effects of electrical treatment upon the insomnias which it can indirectly overcome.

In ordinary cases the symptom of insomnia existing in a mild degree takes care of itself in the general process of improvement without any direct attention. In other and more severe cases attempts to treat this symptom directly by an electric current may be made with:

1. Negative static electrification with positive breeze and spray impressions upon the cranial and spinal centres, or simple positive electrification, or the author's method of potential alternation.

2. The electro-thermal cabinet bath with a combined galvanic and faradic current from the cilio-spinal centre to the feet.

3. Central galvanization.

4. General faradization with either induction coil or Leyden-jar currents.

If the continuous static application is selected the patient should repose comfortably in a reclining-chair upon the static

platform holding loosely in one hand the rod or chain connected with the negative pole. Ground the positive pole and the brass point electrode.

With the machine in moderate motion sweep the point of the electrode sufficiently near the spine to produce an agreeable breeze up and down its entire length. In a moment advance the electrode closer and make a decided spray impression upon the region of the cerebellum and medulla.

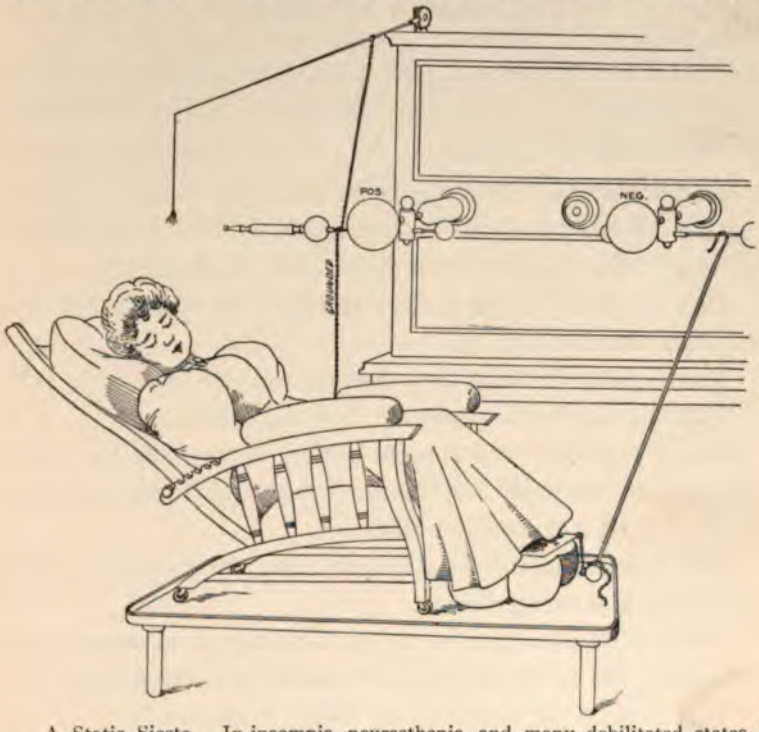
After about five minutes repeat the same impression upon the lumbar spine, and then either adjust the head-breeze electrode at a comfortable distance and continue the administration in this manner for about ten minutes, or, if thick hair, metallic hairpins, or other conditions prevent an agreeable effect upon the head, change the platform rod to the positive pole and give simple positive general electrification.

The method of applying the vibratory electrification with an oscillating potential is described elsewhere. It is exceedingly restful as well as energizing, and under its influence I have seen the patient who had been unable to obtain satisfactory and restful sleep for two weeks, declare that she felt very drowsy and was ready for a nap ten minutes after she stepped upon the platform. This method comes the nearest to producing direct hypnotic effects in insomnia of any known to me.

It is well in these cases to request patients to sit with closed eyes and compose themselves in the most quiet manner. The judgment of the physician should observe and attend to any existing conditions which prevent sleep and call for special treatment either medical, surgical, electrical, or hygienic. Digestion and nutrition very often demand attention. In many cases other resources of static electricity may be added to general electrification, but the indications for their use will be found in local conditions accompanying the insomnia, and each patient must be treated in accordance with the state presented.

Sittings should be repeated daily at first, and in private practice a sedative may be advisable at bedtime when needed until

general improvement obviates the necessity. This will refer mostly to complications of pain. Electricity is not usually a direct hypnotic, and while it is curative of the conditions on which some forms of insomnia depends, it is indirect and requires



A Static Siesta. In insomnia, neurasthenia, and many debilitated states I ground the positive pole and the head-breeze electrode, connect the platform with the negative pole, and compose the patient in this comfortable position. In other cases I omit the head-breeze electrode and simply ground the platform with the positive pole.

time. In suitable cases its benefits are more appreciable, lasting, and satisfactory than almost any other method of treatment.

It is obvious, however, that lack of sleep may be due to causes which lie entirely without its sphere of action, and the compulsory sleep produced by a narcotic is called for in a class of cases radically different from those which are suited to static electrification. Probably electricity is entitled to rank first as a curative agent in ordinary curable cases of insomnia.

CHAPTER XXII.

REMARKS UPON SOME OF THE MISTAKEN IDEAS OF BEGINNERS WHICH EXPERIENCE AND INFORMATION CORRECT.

THAT "static electricity is in its infancy."

That "it has made recent rapid advances."

That "very little is known about static electricity."

That it would be much more valuable "if we could discover anything about it." (?)

That "the polar differences are not well understood as yet."

That the polar differences are "chemical actions."

That a physician who reports curing a case "by the skilful selection of one pole" would necessarily have "aggravated the disease" if he had used the other.

That fanciful innovations in technique really affect the basic principles of current action.

That the whole action of static electricity is something very wonderful, but so mysterious that no one can comprehend it.

That Leyden-jar currents are always "painless."

That the negative breeze is necessarily "stimulating."

That every new discovery about static electricity which is new to the beginner is *new* in fact.

It is rather astonishing to carry back investigations into the early researches of the action of static electricity and observe how closely and accurately the most modern facts in regard to it were known a great many years ago.

This, however, is easily accounted for by the fact that early investigators were among the foremost scientists of their day. From the time of Benjamin Franklin down through the work of Sir Humphry Davy and the middle part of Faraday's own

labors the greatest minds of Europe in the field of physics, chemistry, and philosophy repeated an incredible number of thousands of experiments with static electricity, and if there is any conceivable test of its capacity which was not then made it must relate to some very small matter.

Even its discharges through vacuum tubes were studied with enormous detail fully sixty years ago, but owing to the lack of pumps which would exhaust a high vacuum and the absence of fluorescing screens, Faraday did not produce the phenomena of X rays. The expanding uses of electricity in all fields of both industry and medicine have been extended by collateral inventions, but the actualities of static electricity remain what they have long been known to be.

CHAPTER XXIII.

MISCELLANEOUS CONDITIONS.

Habitual subnormal temperature. Efficiency of static currents in regulating to normal. Treatment. Glycosuria. A clinical case. To abort an incipient cold. Stiffness and soreness of the neck muscles following acute inflammations of the throat. Treatment. Cold extremities. Treatment. Constipation. Colic. Varieties relieved by static sparks. Nausea relieved by the static breeze. Exudations, infiltrations, and localized œdemas. Static methods of treatment. Indications for different forms of application. Effects of treatment and frequency of sittings. Chronic varicose conditions of the lower extremities. Methods of giving practical relief to symptoms by static electricity. Chronic synovitis. Two efficient methods of treatment described.

Habitual Subnormal Temperature.—Many neurotic, neurasthenic, and anæmic states present temperatures from one-half to one and one-half degrees below the normal. Positive static electrification applied for about fifteen minutes raises this temperature to normal. The patient then experiences a sense of well-being and of improved health. When the electrification is repeated daily, or every second day, for a short time, the temperature remains normal and the general improvement in health becomes established. Local applications to the spine will hasten the improvement.

The static current is a mild but very efficient regulator of abnormal function. Heart action, respiration, pulse, and temperature are all adjusted by it to proper action when the derangement is functional only. Even in organic disease it tries to do the same thing and helps materially. It is therefore a valuable auxiliary aid to treatment in various pathological lesions which it cannot directly treat.

Glycosuria.—Mrs. J——, aged 52, widow three years. Dressmaker. Complains of extreme nervousness; is easily

alarmed; has violent headaches; arms below the elbows and legs below the knees fall asleep and get numb in the night; her fingers sting when she gets nervous. She often has cold chills up and down the back, and a feeling around the pelvis as if she was in a bath of ice-water. Has severe pain at the back of the neck and lumbar spine; sleeps very poorly; is constipated; had malaria a year ago. Is extremely anæmic and neurasthenic; is almost unable to pursue her vocation.

On February 26th she had fifteen minutes of positive electrification, with two minutes positive breeze to the spine and occiput. She returned on March 1st; reported that on the night after her first treatment she had had the first dreamless and sound sleep for years; had felt much better for about one day, but since then had felt about the same as before. She was therefore in a hopeful frame of mind, although she had been under constant medical treatment almost continually for three years without any satisfactory relief.

The same treatment was repeated on March 1st, 3d, 5th, 8th, and 10th, making six treatments previous to this writing. She states to-day that she is "indescribably better." She "sleeps very much better, the circulatory disturbance has practically disappeared, she is less nervous, and not only does she herself feel like a different woman but her friends all remark the change. She has little backache and very little headache at any time." An interesting point in this case has just appeared. At the fourth visit, by more careful inquiry into her state, she gave information which she had withheld before. She was passing only about a pint of urine per twenty-four hours, and it was exceedingly irritating. She was requested to take sample to a pathologist for examination, and glycosuria was reported present. A second specimen was requested, and I am now awaiting the final report of the analysis; but without any medication whatever or any change in her diet or habits, the improvement produced by six administrations of static electricity in twelve days has been of a character which probably

no other remedy known to medicine could demonstrate. She will continue treatment, and whatever additional service medicine can contribute she will of course receive, but thus far she has had nothing but static electricity while in my hands.

To Abort an Incipient Cold.—The strong tendency of static electrification to restore to normal the functional processes is most strikingly displayed within the nervous, circulatory, and muscular systems. I have often observed its efficient action in the first stage of a "cold," and the following case is but one of many. It is only selected because it is fresh in mind as these pages are being written.

Miss —— complained one morning of having caught cold the night before; had been awake all night; complete anorexia, nausea, headache, creeping chills, gooseflesh, extremities cold, head hot, and general prostration.

Placed her upon the static platform, positively insulated, negative pole grounded. After five minutes of this positive electrification her symptoms ceased. Head became comfortable, hands and feet warm, nausea absent. Closed *séance* in fifteen minutes to attend to other cases, with the result that symptoms soon reappeared, though with lessened severity.

Two hours later she was again subjected to same positive electrification maintained for *thirty* minutes after all symptoms ceased. She spontaneously declared that she then felt as well as ever, and has since remained so.

There are two lessons enforced by my experiences of this kind with static electricity in acute disturbances: one is, that when no invasion of febrile disease is taking place positive electrification or some static adaptation to the case will direct again the functions into a normal state; second, that the usual short *séance* is ineffective, and that two or more long sittings repeated on the same day will sometimes abort a condition that would otherwise prove tedious and annoying.

Aconite, phenacetin, quinine, and other drugs are prescribed with confidence for these patients, but often fail. My own confidence in static electrification has been the result of actual experience, and if it is possible to give the patient the benefit of

both current and medication, the liability of disappointment is reduced to a minimum.

Stiffness and Soreness of the Neck Muscles Following Acute Inflammations of the Neck and Throat.—When patients are undergoing extended treatment for chronic affections it not infrequently happens that some one of them will suffer from an intercurrent tonsillitis or myalgia of the neck or shoulder, and make the next appearance with a stiff and lame neck. Sometimes they think it is necessary to stop treatment and stay home while they apply liniments or mustard plasters for relief.

A moment's application of warm spray from the brass point electrode followed by a few mild sparks from the same source will give a sense of relief, comfort, and satisfaction that can be equalled in absolutely no other way. The transition from aching discomfort to natural freedom of movement without pain does not take thirty seconds in some cases, and rarely more than five minutes.

If the case is recent, one, two, or possibly three brief applications will make the relief constant.

If the trouble has been neglected and has grown chronic, the treatment is the same, and the final result is the same, but it takes longer and requires several more repetitions.

In chronic cases the application may be made more stimulating by increasing the number of sparks applied.

Cold Extremities.—If these are part of a general condition undergoing electrical treatment, this symptom usually disappears entirely in the course of improvement. If it is due to hepatic torpor, anæmia, or incurable cachexia of any kind, it is not likely that local applications of electricity will produce other than temporary effects and the main treatment must be directed to the cause.

If, however, the coldness is due to disturbances of the nervous system or circulation, or to simple debility, or to any other constitutional or local cause that electro-therapeutics will remove,

the correction of cold extremities requires but a moment's extra attention in the course of the regular sitting.

The general action of positive electrification, and especially when interrupted by the author's method, tends to equalize the body warmth, but in cases in which natural reaction is not taking place during other treatment a few mild sparks should be applied to the soles of the feet through the shoes, and also to the lower part of the forearms.

This is not only effective in warming the feet and hands, but imparts a warmth of a peculiarly agreeable and satisfactory character. Patients coming to the office in the winter-time and who arrive in a cold state, often speak of the gratifying sensation of comfortable warmth which quickly pervades the system during treatment. Under ordinary circumstances it is not usual to administer sparks to the soles of the feet, but I am in the habit of doing this always when the feet are cold, and the effects of the application are always appreciated. They are a sovereign remedy.

Constipation.—Static sparks are not curative of constipation *per se*, but in many cases of general negative states of the health other appropriate measures are advantageously supplemented by the nutritional effects of sparks upon the spine, lumbo-sacral plexus, and abdomen.

As they can be administered in a couple of minutes without removing any clothing, they can often be employed when local applications of galvanic and faradic methods would be out of the question. In this way constipation may sometimes be relieved, but as a direct remedy for chronic constipation static sparks are utterly inadequate. Their usefulness is to be found in their facility of application during the course of treatment for states in which constipation is a minor symptom.

On the 10th of August, 1781, one of the most capable and well-informed medical electricians of that time wrote to a member of the royal society of London:

In the course of my practice I have observed a very remarkable

effect of electricity upon the human body, which is, that it removes costiveness in those persons that are electrified, especially along the course of the alimentary canal. I must observe that it does by no means increase the evacuation of ordinary good habits of the body but only reinstates the usual discharge in case of costiveness. This effect seems to take place because the electrization gives vigor and energy to the fibres of the debilitated intestines in the same manner as it restores the motion of more external muscles.

Colic.—I have repeatedly given relief to lead colic, flatulent colic, etc., by static sparks over the gastric region in cases who were thus affected at the time of coming for other treatment. It would scarcely occur to a patient to seek relief from colic by a visit to the electro-therapeutist, but it is sometimes useful to know that such symptoms can be relieved without extra trouble during a regular course of treatment for some more formidable affection.

Nausea.—I have relieved a number of cases of simple nausea occurring in patients undergoing treatment for other conditions, by a few moments' application of the static breeze to the region of the stomach. In other cases dependent on uterine reflexes bipolar faradic sedation has removed the nausea, and even in the "morning sickness" of pregnancy it has given as much relief to the patient as any other remedy tried.

Exudations, Infiltrations, and Localized Œdemas.—When these are situated superficially, and do not present the induration which calls for negative galvanic electrolysis, static electricity may be applied as a spark or as a Leyden-jar current.

First and simplest is the spark application. Insulate the patient negatively and ground the positive pole. Also ground the brass ball electrode to the gas fixture.

If the state is recent, circumscribed, and soft, apply but a few mild sparks at a time. If there is a possibility of setting up an active inflammation when a low grade of inflammation is present, use a positive and sedative spray until irritation ceases and then proceed with the spark.

If the condition is old, sluggish, and insensitive, and vigor-

ous stimulation is indicated, apply long, thick, powerful sparks in abundance. If the part aches, feels heavy, numb, and cold, these symptoms will be quickly relieved and reabsorption of the infiltrated fluids will be rapidly brought about by strong sparks.

There is sometimes an advantage in using the rapidly interrupted Leyden-jar current as a vasomotor constrictor for the absorption of exudations, and it possesses the very great advantage of being more agreeable than sparks, and if the dose is regulated properly it is not only free from the danger of lighting up a slumbering inflammation, but it can be made extremely sedative to congested and inflamed tissues.

The principle of application involves simply placing a moistened sponge or felt-covered electrode upon each side of the part and passing through the tissues a current interrupted with extreme rapidity, and of a strength which is agreeably borne.

If a considerable part of a lower extremity is affected, a larger electrode connected with the positive pole may be placed under the sacrum or on the anterior part of the thigh while the negative electrode is promenaded in the course of the blood-vessels of the œdematous tissues.

Treatment by either form of application should afford positive relief at each sitting and be repeated every second or third day until benefit is established and further improvement ceases. If the case is very recent, and will require but a few applications, they should be made daily.

Chronic Varicose Conditions of the Lower Extremities.—In these old cases there is often enlargement of the leg, severe aching and pain, and inability to wear a shoe or to walk, except with difficulty and for short distances. I do not refer to simple varicose veins, but to states of long-standing, chronic congestion, and rheumatic symptoms associated with the varicosis.

An elastic stocking has many drawbacks, and is an exceed-

ingly poor excuse in the way of treatment. Static sparks are far better, and possess remarkable value in affording symptomatic relief when the anatomical integrity is irreparable. Relief from the sense of heaviness, aching, and pain, and the ability to wear a shoe and to walk with comfort is frequently all these patients require to make them grateful, and static electricity will afford them this relief as certainly as anything in medicine.

Seat the patient upon the static platform connected with the positive pole, ground the negative pole, and ground the brass ball electrode. Revolve the machine rapidly enough to produce a strong current, as the tissues are generally insensitive to sparks, and not only do not benefit from mild applications, but the patient enjoys a rather agreeable sensation from powerful sparks, such as are required to relieve.

Apply long single sparks at the rate of about sixty per minute over the entire affected part except the "shin bone," which is too sensitive to endure such an application. If the ankle is œdematous, sparks will reduce the infiltration and increase the mobility of the joint. Only a very moderate decrease in the size of the leg may take place, but all pains and aches will be removed, the sense of great weight will be superseded by a feeling of buoyancy, shoes which pinched before can be worn with comfort, the walking ability and endurance will be restored, and the condition will cease to cripple the patient.

These effects are produced at each *séance* in less than five minutes' time. For the general improvement of the patient I am accustomed then to change the platform connection to the negative pole and apply mild positive sparks to the other leg, to both thighs, and to the spine so that the patient leaves the office "feeling as good as new."

When treatment is first begun the sittings should be daily until painful symptoms are removed, and then three times a week for a couple of weeks longer. If relapses occur during the years to come, a short course of treatment may be repeated

at any time, and the patient can thus maintain the comfort of a practical cure even though the appearance of the leg may not have improved to the same extent as the symptomatic relief.

Chronic Synovitis—"White Swelling" of the Knee-Joint.—Static electricity offers two efficient methods of treatment—sparks and the Leyden-jar current.

Insulate the patient negatively, ground the positive pole and the brass ball electrode to the gas fixture. Apply mild sparks to the affected joint, or stronger ones if they are well tolerated. Request the patient to bend and pose the joint to bring out the local pains during treatment and in each position spark the tissues until relief ensues. Repeat every second day until improved and then three times a week until benefit ceases.

If the part is still sensitive and sore to the touch sparks will not be tolerated, and the Leyden-jar sedative-tonic application may be made far more agreeable. Apply two sponge-covered hand electrodes to the opposite side of the joint, connect the smallest jars in circuit with a short spark-gap, rapid action of the plates, and a mild current.

Pass one electrode very slowly over the area affected while the other is held stationary. The question of polarity is not important, and if the negative electrode is somewhat larger than the positive the sensation of the two will be about the same.

Continue the application until all stiffness and pain are relieved. If any particularly sensitive spot is found, hold the positive electrode upon it, with a regulation of the dose at the point of comfortable tolerance, until sedation is complete.

CHAPTER XXIV.

HEART DISEASES, CHRONIC GRIEF, AND WEATHER NEUROSES.

Functional heart derangements. Indications for static electricity. Its benefits and its limitations. Necessity for proper selection of cases. The treatment of chronic heart diseases. The great value of static electricity in suitable forms of administration. A review of other methods of treatment, showing the advantages offered by static methods. Its nutritional value in incurable cases. Clinical examples of organic and functional cardiac lesions benefited by static electricity. Acute or chronic grief. Effects of grief upon the human organism indicating the sedative-tonic and nutritional actions of static electricity. Clinical remarks upon treatment. Weather neuroses. Symptoms worse from weather changes. Their cause. Treatment by static electricity. Its nutritional and function-regulating influence in these morbid states. Methods of application.

Functional Heart Derangements.—So far as these are caused by other conditions which are satisfactorily treated by medication, there will be little occasion to employ any form of electricity in their treatment.

To relieve the patient's anxiety, however, to restore the nervous tone, and assist in transforming irregularity of the cardiac function into a normal process, general positive static electrification will always be useful and possesses a definite value.

If the case is recent and due to a temporary disturbance, one, two, or three applications will be found sufficient.

If the patient is anæmic, debilitated, or in any chronic condition which deters the heart from normal action, such patients can be benefited in so many ways by static electricity repeated three or four times a week for a couple of months that it is good practice to employ it.

If palpitation and irregularity are caused by acute dyspeptic states, other measures are of course simpler and less expensive

to employ, and as they are entirely adequate I never suggest electricity to such a patient.

If chronic dyspepsia accompanies the cardiac disturbance, or causes it, the action of static electricity will be much less favorable when there is a low grade of catarrhal gastritis present than when the dyspepsia is of the nervous type. As a matter of fact, static electricity is apt to be disappointing in the treatment of many conditions of the digestive tract, and apart from the fact that it is less suited to some of these cases than others we encounter the additional difficulty of combating the aggravation caused by each of three meals a day by treatments which are seldom administered more than three times a week, while medical remedies are given after each meal.

If the cardiac neurosis is simply part of a general neurasthenia static electricity is the remedy *par excellence.*

The Treatment of Chronic Heart Diseases.—As a remedial agent with a marked tendency to regulate and sustain the normal functions of the body static electricity becomes one of the best of heart tonics and is probably the very best extra-drug therapeutic measure in both functional and organic diseases of the heart.

The following remarks refer to heart affections with cardiac inefficiency. The precise character of the lesion is of subordinate importance as compared with the fact of inefficiency or the liability of heart failure from lack of compensation. In order to bring out an appreciation of the full measure of value of static electricity in these cases the physician should carefully read the preceding chapter upon the actions of static currents within the living tissues and compare them with the following excellent summary of modern treatment by Satterthwaite.

There is a widespread and a growing interest in this matter (the treatment of chronic heart diseases), and I am firmly convinced from an investigation of it that we are able to do much more for these cases at the present time than we did a few years ago.

The older methods, as we all know, were, in the order of importance named, first, complete rest, venesection, and hydragogue

cathartics, followed by the usual heart tonics; and this antiquated system in the above order of values has been advocated in one of the latest American books on the practice of medicine.

I admit that there is a positive advantage to the wearied heart from the absolute rest from toil or worry that comes from a complete suspension of bodily or even mental activity; and that a certain amount of rest in bed may be desirable occasionally and for brief periods. But any improvement gained by this treatment soon ceases unless the enforced rest is supplemented by some activity of the muscular system, whether active or passive; or some additional relief for the overloaded heart by the use of one or other of the numerous remedial agencies we have at our command. Treatment by venesection and the old-fashioned hydragogue cathartics we need hardly allude to. The former, as will be generally admitted, has had its day; while the latter are certainly and rapidly being replaced by other remedies that are both efficacious and more agreeable to our patients.

Next in order I will speak of *diet*. I feel that this is a most important topic. In many of these chronic cardiac cases I agree with Grainger Stewart, who has recently reviewed the new methods of treatment in cardiac diseases, that the nitrogenous food should be increased, while the carbohydrates should be reduced; but I do so for two reasons. First, that a less amount of food is required by the body; and second, that by diminishing the carbohydrates we lessen fermentation, and so reduce to some extent gaseous distention of the stomach and its necessary result, pressure on an already distended heart. But I am opposed to in any great measure restricting the use of the carbohydrates, because they are needed to supply energy to the system. With these qualifications as to the kind of food, it will be seen that I favor a *mixed diet*. It is common to advocate a diminished use of liquids, but in many cases, as when lithæmia is associated with cardiac disease, there is an excess of uric acid found in the secretions. In these cases I advocate liberal potations of fluid. Chemistry teaches us that uric acid is readily dissolved in water, and practical experience shows us also that lithæmia is also greatly benefited by this liquid. Hence I favor the free use of water and am opposed to the so-called *dry-diet* system; but I do not advocate taking large quantities of fluid with the meals. Fluids should, in these cases, be taken between meals, if a large amount is to be taken. Where it is practical, diffusible stimulants, as, for example the aromatic spirits of ammonia, may be substituted with benefit for alcoholics. Tobacco, coffee, and tea, as a rule, are to be prohibited, and yet there are notable exceptions as to coffee and tea. Sometimes coffee is so great an aid to stomach

digestion that it is almost indispensable. Tea, if taken, should be weak. In these matters experience, skill, intelligence, and tact on the part of the physician are of the very first importance.

Next in order, in my opinion, come *regulated exercises*. It may be remembered that these were hinted at by Stokes some forty years ago, but he did not appreciate their real value, and did not systematize them. Of first importance are the modern systematic resisted movements, and are associated with the name of the Schott brothers, of Nauheim, in Germany. It appears that these men, while treating neurasthenics, found that in forcing the blood to the nerve centres, the volume of the pulse was increased, while at the same time its rate was diminished. As this result was desirable when treating loss of compensation in heart disease, they applied the method in these chronic cases with such satisfactory results that they have been recognized and employed by many of the practitioners of Europe.

In all, there are three classes of exercises practised by the advocates of movement. First in the severer cases, as in dropsy, or in very feeble patients, there are passive movements and also resisted movements by the physician or operator, who may also employ light but not deep massage. Second, there are slow voluntary movements of the patient resisted by the operator. Third and last, there is the Oertel treatment or some modification of it, an elaboration of Stokes' idea—the so-called mountain-climbing method.

In the Schott system, the exercises are all extremely gentle; the physician or his assistant always stopping short (in the movements) of any weariness on the part of the patient, and its resultant rapid breathing or increased rapidity of the pulse. If either of these undesirable phenomena occur, the exercises are immediately suspended and the patient is made to rest; and in any case, after each variety of movement there is always a breathing spell. The attendant never grasps the part with force, but with some firmness, and supports the patient with both hands while he resists each movement, and he always restores the limb to its original position, whether the patient is standing, sitting, or lying down. Both hands of the operator are always needed to give the movements in the manner most agreeable; meanwhile the patient is instructed to breathe naturally. If there is any paleness of the alæ nasi, the movements are at once arrested. A fundamental principle underlying this treatment is that each muscle of the body is to be made to work with a gradually increasing force, continuing to the close of the treatment. The movements are simple in character, being flexion, extension, abduction, and rotation, applied as nearly as may be to the limbs, neck, and trunk. The experience and intelligence

of the physician are naturally of vast importance if the treatment is to be successfully carried out in each case. It is not a routine method.

After each *séance* the heart is examined and also the pulse. Usually the heart is improved in action and with it the pulse, and the heart is more or less contracted. During a complete course these changes are at first more or less evanescent, but finally become more permanent. The patients also express themselves as feeling better, or else there is some improvement noted in the physical signs. The *rationale* of successful treatment is explained in various ways, but it is generally believed that the muscles during these movements, constituting as they do from one-half to one-third of the weight of the body, empty the veins and lymphatics during contraction, and in so doing diminish the peripheral resistance, as it is called, so that the arteries, which are not squeezed by the contraction of the muscles, have less resistance, and can therefore carry the arterial blood in them with great ease and completeness to the periphery. After a variable time, however, following each *séance*, the venous blood and lymph flow back again to the periphery and again the heart is in labor. But it has already gained some relief, and after every successive day of treatment it is apt to gain steadily in tone. The resisted movements are designed to produce tonic contraction of the muscles just short of producing a sensation of weariness in the patient. It will be seen that this method is best adapted for cases that still have a fair amount of cardiac tone remaining.

Most or all of these plans are modifications of the Schott method.

The Oertel plan is for the patient to climb hills, increasing the distances gradually. At Nauheim these distances are marked by guide-boards (*Terraincur*). This method is certainly not applicable in severe cases, for the patient must have considerable strength in the cardiac muscle to attempt it. Accordingly, it plays an inferior rôle in heart treatment. Sometimes these various plans are more or less modified, but, on the whole, the Schott treatment has met with the most favor and appears to have given the best results.

Next comes the *treatment by baths*. In this plan the patient is immersed in a bath of warm salt water that has been carbonated. The effects of these baths, in my experience, are much the same in quality as the exercises, but on the whole they are less efficient. In the case of a young girl with a dilated heart, the result of congenital disease, I examined the apex beat with the finger before the bath and then after it, and found that the apex receded toward the median line fully three-quarters of an inch, while the pulse fell

from 124 before the bath to 100 five minutes after the bath. Meantime the pulse increased in strength. The bath lasted four and a half minutes. The system adopted in these cases is as follows, usually: After a variable period of rest, before beginning the course in severe cases, the patient is immersed in a warm and slightly saline effervescent bath; the duration of the immersion being from four to fifteen minutes, and the temperature 95°. Then, as the course proceeds, more and more salines are introduced, and more and more carbonic-acid gas. After every third bath or so there is an intermission of a day, and this period is taken by the physician to auscult and percuss and make such other examinations as are necessary. Assuming that a course lasts from four to eight weeks, while the potency of the bath is thus gradually increased, there is usually a coincident reduction in the temperature, which may be carried down to 85°, according to the capacity of the individual for agreeably sustaining such a fall of temperature. In feeble cases, where the cardiac tone has been lost, baths will restore it sooner than exercises. When, however, from any reason, baths cannot be employed, the method by exercises will produce satisfactory results, though a longer period will usually be needed.

The theory of these baths is uncertain. It has been claimed by some that the warm water relaxes the arterioles of the skin, and so overcomes the natural resistance, admitting of stronger and slower action by the heart. Others maintain that the action is reflex from the nerves of the skin to the arterioles of deeper parts. Others again have held that the effect is mental. According to Grainger Stewart's experiments, the effects are chiefly due to the carbonic-acid gas in the water. It numbs the skin. Stewart tried various kinds of warm baths, but the diminished area of cardiac dulness with improvement of the pulse only followed after the introduction of carbonic-acid gas into the bath. But both exercises and baths are only useful up to a certain point. After this point has been reached they are harmful. To make this treatment effectual, it is very important that the patient resume his work gradually, accustoming himself to it by slow degrees. Cases that are to be specially avoided in the treatment by exercises and baths are: acute heart affections of any kind; aneurisms, except in the very early stages; and arterial sclerosis, when it is well marked. To get the full benefit of this course of treatment the patient should follow it up by two or three weeks of rest at some climatic resort of medium altitude.

In conclusion, I will briefly review our medicinal remedies. Of these, digitalis still continues to stand at the head of the list, whatever theoretical objections may be urged against it in special cases.

Next in order comes, with a wide interval, strophanthus. It acts promptly, and is often useful in emergency cases, but is unreliable in action, and should not be continued for a long period. Caffeine is a safe and reliable remedy in many instances. In old cases of stiffened arteries, I have had great benefit from nitroglycerin, while iodide of sodium and iodide of potassium are valuable in many cases, because their use can be prolonged. They are especially serviceable in lithæmia. All cardiac tonics should be used cautiously in a fresh exacerbation, such as may occur in rheumatism. In this connection I should warn against the use of strychnine. In the neurotic forms of chronic functional disturbance, great benefit may be obtained from meals taken at short intervals. Bromides and other sedatives, or even preparations of opium, may also form essential parts of the treatment; but we may be able to succeed without them by the use of sulphonal or paraldehyde. Such has been my experience. Finally, arsenic and iron must not be forgotten as valuable adjuncts in certain classes of cases.

Apart from the beneficent action of general static electrification upon purely functional processes, the mechanical superiority of static massage or muscle-contracting applications for exercise, nutrition, and general muscular tone, to the crude and clumsy methods advocated by Oertel, Stokes, and Schott must be at once apparent to every one who is familiar with the best electrical methods.

The treatment by baths also possesses disadvantages as compared with static electricity. Both baths and exercises must be employed with a careful selection of cases and great care in the adaptation of treatment to each individual condition. They are tedious in detail, slow to act, and require to be kept up for a long period.

The *rationale* of successful treatment by these methods does not differ in any important way from the actions of appropriate static administrations. The greatest difference lies in the fact that with static electricity the patient may be treated by the physician himself without delegating any responsibility to either the patient or a third hand, and that: (1) the treatment is accomplished in ten or fifteen minutes with the patient seated in a comfortable chair and not subjected to any exposure;

(2) there is no removal of clothing; (3) the care in selection of cases is reduced to a minimum, for general electrification and its mild action in aid of the normal functions is suited to every case that can by any possibility come to the office—and local methods which may be superadded for symptomatic conditions are wholly devoid of danger in the hands of any physician who possesses ordinary skill in electro-therapeutics; (4) the benefits of treatment are more agreeably obtained, more quickly apparent, and are maintained at a point which keeps the patient comfortable with far less time and trouble than the Schott exercises.

When the patient is anæmic and weak and cannot get warm or keep warm, or has advanced to other marked disturbances of the circulation, the action of drugs and the precautions of hygiene may be efficiently aided by means of the static apparatus.

The following cases were reported by Caldwell:

Mr. G—— came to me with organic heart disease. Upon examination I found an enormously dilated heart, and he was suffering from all the aggravated symptoms that come with such a condition—shortness of breath, radial pulse very intermittent and irregular, cold extremities, and inability to lie down at all for fear of suffocation. Altogether, after finding out his true condition, I hesitated about giving him any treatment, fearing he might die some day in my office and it be said electricity had killed him. He was one of the first of such patients I had had an opportunity of trying the static current on, and I gave it cautiously, using the positive insulation for eight minutes three times a week. It had the effect of a heart tonic, strengthening and quieting its action. The pulse grew stronger and less intermitting, the breathing better, and at times he was able to lie down. While the patient was not cured, his last year was rendered much more comfortable by the treatment.

Rev. Mr. —— came to me suffering, he said, with heart disease. Palpitation, vertigo, irregular pulse, a great deal of occipital headache, with insomnia, were some of his symptoms, and he was greatly excited with the fear I would tell him he must die. Upon examination I found there was no organic lesion whatever; merely a functional condition due to mental overwork. The pulse would intermit about every fourth beat. In

this case I employed the negative insulation for ten minutes daily, and after the second treatment he was entirely relieved, as far as his "heart disease" was concerned. In two months' time discharged him cured.

Mr. W——, a young man, by trade a printer, came to me in a condition similar to second case, though more highly aggravated, and also suffering severely from dyspepsia, which caused a great deal of flatulence, especially at night, after dinner, when the fulness caused by it was very oppressive. His condition was induced by his running rapidly up seven flights of stairs to his business office rather than wait for the elevator, and he was in a very excitable, nervous state.

I gave him negative insulation five minutes, positive direct head breeze four, and positive direct breeze down the spine four minutes; treatment given three times a week.

The most aggravating heart symptoms were relieved at once and have never since returned, and the dyspepsia was speedily cured.

Dr. W. S. Watson, Fishkill, N. Y., reports a typical case:

Mr. W—— came to me suffering with, as he stated, heart failure. He was troubled very much with the shortness of breath and palpitation, some considerable vertigo, pains in both parietal regions, which disturbances unfitted him for his employment. The patient was a man of full, plethoric habit, just such a man as one would expect to see come down with apoplexy. Upon examination, I found no evidence of any organic lesion, trouble entirely functional, palpitation due to the accumulation of gas in the stomach, as is often the case, and to disturbance of the portal circulation and an excess of uric acid in the system, all of which conditions are amenable to the static current.

Treatment was begun by giving him ten minutes of positive static insulation, followed by static breeze up and down the spine and laterally to both temporal regions. After the first treatment the shortness of breath subsided very largely, the extremities became warm, and the palpitation less frequent. After the third treatment he felt like a new man, could walk off at a brisk rate a mile or more, and experience none of the alarming feelings. Treatment was continued every second day for about three weeks, when he was discharged without any remaining evidence of biliary disturbance or excess of uric acid.

Acute or Chronic Grief.—The effects of grief upon the human organism are often equivalent to the effects of a slow-

acting poison. Grief and shock, from a medical standpoint, are conditions admirably considered in the following citation from a recent writer:

> Medical observations show that the physical result of depressing emotions are similar to those caused by bodily accidents, fatigue, chill, partial starvation, and loss of blood. Birds, moles, and dogs, which apparently died in consequence of capture, and from conditions that correspond in human beings to acute nostalgia and "broken heart," were examined after death as to the condition of their internal organs, and it was found that the nutrition of the tissues had been interfered with, and the substance proper of various vital organs had undergone the same kind of degeneration as that brought about by phosphorus or the germs of infectious disease. To urge work, study, travel, the vain search for amusements, is both useless and dangerous. For a time the whole organism is overthrown. Readjustment comes slowly. Sorrow, grief, and all great misfortunes should be regarded as conditions similar to acute infectious diseases, which they resemble in result, and later as convalescence from such diseases. Seclusion, rest, sleep, appropriate food, fresh air, sunshine, interests that tax neither mind nor body, these are requirements in this class of illness.

To this writer's therapeutics for this class of cases should be added general electrization. No one informed of its nerve-toning properties and nutritional effects could withhold from these patients a remedy equally indicated with sunshine, diversion, and rest. I have had the opportunity of corroborating its effects in tranquillizing overwrought emotions and in the profound melancholia of sorrow, also in severe shock, two cases of which I recall very distinctly, and my views of the value of nutritional, sedative-tonic electrization have been confirmed by personal experience in a large number of instances. It is more rational and satisfactory to all concerned to treat intense grief as a disease and shorten its duration by the efficient use of electricity than to leave the patient to time and circumstances to outgrow it.

In the treatment of the great class of diseases and symptoms which require functional regulation or nutritional improvement, general restorative measures are nearly always indicated. So

far as these come within the resources of electro-therapy the advantages of static applications are decided.

Static treatment may be quickly given without taking off a garment, and its physiological action upon the general functions and the processes of nutrition are more practically available than similar actions of other currents.

In office practice the static machine will enable the operator to retain cases that he would otherwise abandon, or who abandon him because of discouragement as to results. The loss of these cases will soon offset the cost of the machine.

Although facility of application is a point that is justly dwelt upon by every experienced operator of the static machine, and short *séances* are cited as the rule, yet too much haste is not advisable in general administrations. The beginner especially will do well to take plenty of time. Much better results will accrue in the long run to the operator who takes fifteen or twenty minutes to do deliberately what only an expert can crowd into half the time.

Weather Neuroses.—There are various well-known diseases of the nervous system whose symptoms, or at least the intensity of whose symptoms, are greatly influenced by the state of the weather. This is true both of diseases which may be demonstrated anatomically and of various neuroses.

Examples of the former are the lancinating pains of locomotor ataxia, chronic myelitis, meningomyelitis, multiple neuritis, and various neuralgias. Examples of the latter are hysteria, neurasthenia, and epilepsy.

It is also well known that the state of the weather influences the disposition, desire, and ability to work of a great many nervous people. In addition to these conditions there are, however, various others whose presence is manifest only during certain states of the weather. At other times the patient usually makes no complaint. The symptoms of these weather neuroses are pain, often of a lancinating character, disordered sensibility, and muscular weakness.

The localization, distribution, intensity, and duration of these are subject to great variation, and complications may exist with other nervous conditions, such as neurasthenia, etc.

The development of these neuroses is usually due to anomalies of *nutrition*. The majority of cases of pains in the joints and extremities in old people which are usually considered as chronic muscular rheumatism are regarded by Lowenfeld as more properly to be looked upon as weather neuroses. In health there is a perfect adjustment between the centrifugal pressure of the circulation and the centripetal pressure of the weight of the atmosphere. Changes in the latter, as indicated by the fall in the barometer at the approach of a storm, are readily compensated for in the softer tissues by the freer movements of the nerve fibres when the intravascular pressure is unbalanced, but in the denser fibrous tissues of the body the nerve filaments cannot escape from pressure and consequently express themselves in pain. The susceptibility of patients with any form of fibrous-tissue inflammation, rheumatic, gouty, etc., to changes in the weather is due to a similar cause.

Lowenfeld refers at some length to these conditions and summarizes treatment in the brief remark that it should consist of "electricity to the back and over the course of the nerves, with attention to the general nutrition." Equally indefinite are most of the references to electricity in books of general medicine. Without hint as to current, polarity, dosage, or manner of treatment, the practising physician is unable to follow such a writer. These symptoms of disordered nutrition, these peripheral neuroses, call for nutritional applications of general static electricity.

Seat the patient upon the platform connected with the positive pole and apply a strong positive charge—preferably potential alternation—for about five minutes. Then stop the machine, connect the platform with the negative pole, ground the positive pole to the water pipe or gas fixture, and also ground the brass point electrode. With the plates in vigorous action

apply a positive spray to the spine for three minutes by sweeping the point up and down its entire length, just far enough away to avoid a spark.

Apply the same spray to the forehead, vertex, occipital region, or any part of the head which may be subject to pain. Below the neck attack the sites of pain with the grounded brass ball electrode, which should be next substituted for the metal point. Apply sparks to the entire spine, to the muscular parts of both upper and lower extremities, and to the distribution of all nerves manifesting symptoms. The first application should be very mild, and the later dosage adjusted to the patient's needs, according as the improvement progresses or relapses. Devote five or more minutes to this part of the *séance*.

If the patient is elderly or feeble a semi-reclining chair with cane back and cane seat should be employed, so that the full sedative-tonic, nutritional effects of the positive electrification and breeze may be realized with the system at complete rest, and in these cases the use of sparks should be delayed until late in the course of treatment, and unless they are indispensable they should be omitted altogether.

Repeat treatment three times a week in chronic conditions, but in acute exacerbations the sitting should be daily until relief becomes sufficient to extend the time. Those who do not possess a static machine but wish to employ electricity, may attempt to combat these conditions by general faradization.

CHAPTER XXV.

THE VALUE OF ELECTRO-MUSCULAR AND NERVE STIMULATION IN TRAINING FOR CONTESTS OF SKILL, STRENGTH, SPEED, ENDURANCE, AND DEXTERITY.

THERE are many forms of brain and muscle competition for the prize of supremacy in special fields. Contests exact the most rigorous preparation and the most perfect health. The chess champion must have good digestion or his head will not be clear. The fastest "sender" in a telegraphers' tournament must have speed, buoyancy, and endurance in his arm, and the bicycle champion must have the quick-leg movement of a winning gait. Throughout the whole range of sporting, athletic, and intellectual contests, whatever will lend stamina and quickness to the powers employed, will aid the winner to surpass his keenest rivals. The time and labor involved in training are often great, and the expense is frequently a considerable item to the amateur.

The time and labor of preparation may be reduced one-half and the effectiveness of careful training of either the mind or body, or both, can be materially increased by the vitalizing, nutritional, and muscle-contracting properties of electric currents.

Oarsmen, runners, walkers, jumpers, weight throwers, acrobats, athletes of all sorts, cyclists, boxers, fencers, and others whose training involves laborious exercise, free perspiration, and "rubbing down" can be more speedily rested, relieved of the products of rapid tissue combustion, and re-invigorated by the electro-thermal cabinet bath than by any other means.

As a substitute for more than one-half of the time devoted to active exercise their muscles can be given increased buoyancy, firmness, and responsive action by the powerful stimulus of the static spark or slowly interrupted Leyden-jar current. The arm of the baseball pitcher can be maintained at its highest efficiency by means of the interrupted current from the static machine.

So, too, can the arm of the telegrapher have its every fibre keyed to highest speed and sent into a tournament with nearly ten per cent added to the best rate that practice alone could give. By adapting the method of employing some form of electric nerve and muscle stimulation to the requirements of the case, a finishing touch can be imparted to ordinary training that can be obtained in no other way, for while voluntary exercise fatigues the mind, electrical exercise does not. Fifteen or twenty minutes daily devoted to an electrical nerve and muscle stimulus under a physician's direction would place a man at his best, with a saving of more than one-half of the daily work which is considered training. The advantages on the side of electricity are: Economy of time and labor. The avoidance of heart strain and fatigue while receiving powerful nerve and muscle stimulation. No liability of over-training and going stale. More rapid elimination of the products of waste. More rapid rest and recovery from fatigue. A constant tonic action upon the digestion and nutritional processes. Increase of clearness in cerebration. The increase of fitness to the highest possible degree by supplementing the best-known methods of physical and mental training.

The one desideratum is that the form of electricity shall be properly selected and employed, and the proper form is the static current. If, at the end of training, a *séance* is given immediately before the trial of skill takes place, the contestant who has been "warmed up" by electricity without exhausting the smallest fraction of his strength and nervous force, but with the subtle addition to his energies that this remarkable

agent imparts, will meet his rivals feeling confident that victory is within his grasp.

His mind will be clearer and steadier, his muscles will be more buoyant and alert, his spirits will be higher, his courage finer, his endurance more equal to the call upon it. In accomplishing this end the resources of static electricity are general positive electrification, the positive and negative spray, sparks, Leyden-jar currents, and the author's method of potential alternation. The methods of employing each are the same as those which are familiar to all operators, and the actions within the tissues are clearly set forth in the chapter on electro-physiology.

CHAPTER XXVI.

HEADACHES.

The local treatment of pain in the head. Constitutional treatment by static electricity. The advantages of curative effects over drug palliation. Methods of employing static electricity. Kinds of headaches static electricity will permanently relieve. Varieties in which its action gives only temporary relief. No other single agent so satisfactory in the treatment of headaches. Migraine. Its successful treatment by static electricity. Good effect upon the patient's general health. The relation of common conditions to success or failure in general electro-therapeutics.

For the relief of headache during an attack static electricity in the form of a breeze or spray directed upon the part of greatest pain is an efficient measure in congestive and nervous headaches and some others.

The local treatment of pain in the head is perhaps the least important part of the influence which all forms of electricity exert in the relief and cure of headaches. The symptom is so common an accompaniment of derangements or disease elsewhere than in the head that local treatment is required in only a very small proportion of the cases that come to the office of the electro-therapeutist who employs cell and coil currents alone.

During the treatment of the cause the headache in most cases is permanently relieved or greatly lessened. This is especially true in the use of the galvanic and faradic currents, but in the use of static electricity practically every treatment is constitutional as well as local, and if headaches are habitual or are present at the time of treatment the same administration that relieves the pain tends to promote the permanent cure.

As there is but very little difference in the form of applications to the head, the separation of headaches into thirty or forty different varieties is of value only so far as it relates to the probable prognosis.

Some headaches will be rapidly relieved by static electrification, and if benefit is maintained by a sufficient course of treatment it will gradually become permanent. These headaches are those which arise from functional disturbances of the nervous and circulatory systems and the pelvic organs and perversions of nutrition.

Some headaches which are a symptom of diseases which are amenable to benefit by static electricity will also undergo gradual improvement while the disease is being treated. The headaches of rheumatism, gout, malaria, and some kinds of dyspepsia belong to this class.

Severe head pains which are due to grave or chronic disease, or pressure within the cranium—causes which the static current cannot directly affect—may often be mitigated in their severity. It is obvious that a very great advantage of static electricity over the "headache powders" now for sale in popular dry-goods stores and on all druggist counters without the formality of a competent physician's advice is the decided general benefit which it imparts whether it palliates or cures, and that in no case is it liable to do any harm whatever. When the anæmic victims of habitual and severe headache resort to "powders," which they buy as common merchandise, and take with twofold ignorance of either the nature or the action of the drug, the consequences may be oftentimes disastrous. It is certain that many people injure their health in this way.

If the patient is receiving other electric treatment and has a headache at the time, the method of relief will be the application of some form of breeze upon the area of pain.

This may be the frontal region, the vertex, one or both sides of the head, or the occiput. If the headache is nervous or con-

gestive, or the scalp feels sore and bruised, or is relieved by cool applications, I consider the positive head breeze indicated, and apply it with the strength regulated to comfort until the headache ceases. This may require five or ten minutes.

If it is a very obstinate ache I have observed that after five or six minutes the sense of relief has only begun to manifest itself and that about double this time will be required for the *séance*. If, however, a state of comfort is not obtained under thirteen or fifteen minutes it has been my experience that the headache was not suited to this remedy. Bilious headaches and those dependent on the dragging of a uterus which needs support are of this character.

If the headache is one which seeks stimulation rather than sedation for relief I employ a negative breeze; but in this case it is much more necessary to employ a hand electrode and keep the breeze in motion if the hair is thick and resisting. A strong negative head breeze from a fixed electrode is wellnigh intolerable to a scalp which is covered with thick hair, but the irritation may be reduced by keeping the electrode in motion or by interrupting the breeze as I have described elsewhere.

Upon the whole, the amount of attention to give headaches—whether to treat them locally or trust to the general treatment; whether to expect temporary relief, partial improvement, or a permanent cure, or whether to disregard electricity entirely and prescribe other measures—is a matter for experience to teach the operator of the static machine, and the ground cannot be fully covered in a text-book.

I have now a case of a woman, about thirty years of age, who simply sits upon the static platform to hold her infant while the child is subjected to positive electrification for about ten minutes three times a week. She lately informed me that she had had habitual headaches since the age of nine, and that she could remember very few days of her whole life when her head

had been entirely free, but she had noticed that she was now free from headache more than half the time, and that her head always felt comfortable for the remainder of the day following each sitting.

The curative tendency of electrification is very marked and very persistent, but there are so many causes of headache which are beyond its reach that a reasonable amount of judgment must be employed in deciding whether to treat locally or not.

Migraine.—Seat the patient comfortably on the negatively insulated static platform. Ground the positive pole to the water pipe or gas fixture. Concentrate a positive head breeze upon the site of pain, regulating the intensity to the state of the patient's head and hair. The space between the head and electrode may usually be from twenty down to twelve inches.

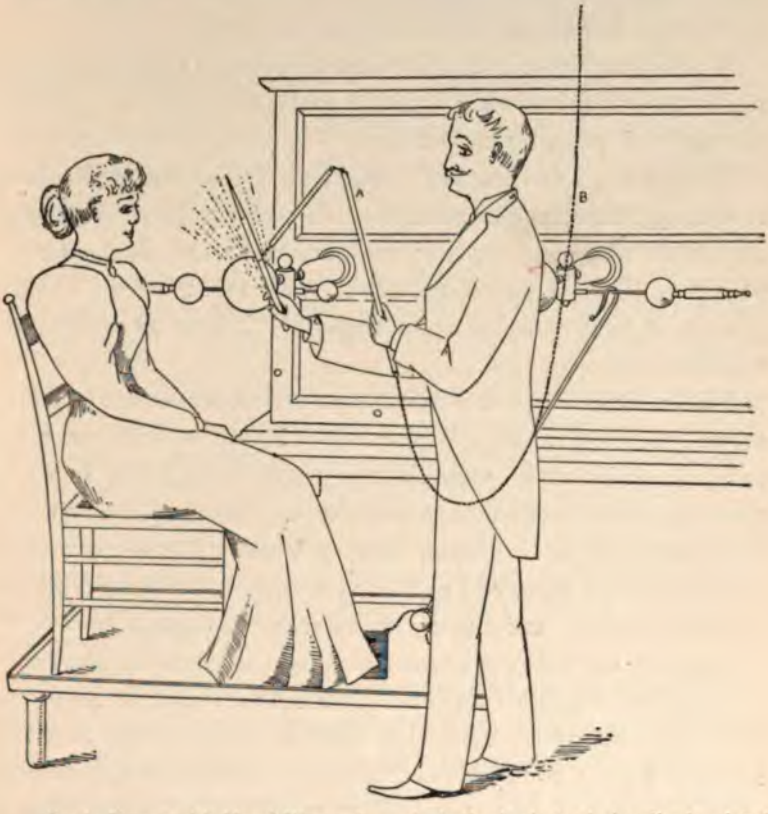
Continue head breeze three minutes after all pain ceases at each *séance*. Then apply a general nutritional treatment to the spine and entire body, with the brass point electrode so manipulated as to cause an agreeable glow throughout the system, tone up the heart action, raise the temperature to normal, and dispose of the cold extremities which these patients so often have.

Close the sitting with a few moments of sedative-tonic positive electrification. The total time required for thorough treatment is rarely over fifteen minutes. Repeat daily at first until relief lasts two days. When improvement is established continue three times a week.

In two or three months, sometimes sooner, relief becomes permanent in the majority of cases. The expert operator can hasten the results by attention to the special idiosyncrasies of each case.

If the constant head breeze is felt to be uncomfortable the point electrode swayed in the hand will make it satisfactory. If the hair is thin, and the clothing is of neutral fabrics, thin or tightly woven, positive electrification may be preferred to

obtain the stronger negative breeze; but in all these cases the choice of poles must be governed by the strength of current given out by the machine.



Static Breeze with Hand Electrode. *A*, Author's electrode-handler insulated with hard rubber; *B*, the terminal chain connected with the gas fixture. The dotted lines were designed by the artist to indicate the movement of the point during application to the frontal region. The electrode should be directed more horizontally towards the patient than is shown in the diagram. Either pole may be connected with the platform and the opposite pole grounded. The principle is the same whether the breeze is applied to the spine, head, or any other portion of the body.

The head breeze may temporarily relieve the pain at the time of the paroxysm, but curative results depend of course upon regular and persistent treatment for several months.

Along with relief from pain there is a general upbuilding of the patient's health, which will remain of great value to her for a long period, and it is this decided constitutional gain which adds a peculiar satisfaction to the use of static electricity in a disease in which drugs so often fail.

If complications exist they must of course receive care, but the treatment of migraine itself by static electricity will rarely disappoint if properly carried out.

The Relation of Common Conditions to Success or Failure in General Electro-Therapeutics.—There are three prevalent conditions which occupy an important relation to electro-therapeutics and call for special remarks. These are anæmia, chronic gastric ill health, and a state popularly known as bilious or malarious.

Electricity holds a subordinate place in their ordinary treatment. In most cases of anæmia the action of iron, arsenic, and other chief drugs administered three times a day is much more rapid and satisfactory than static electricity alone when it is administered but three times a week. Electric currents do not take the place of hæmatic remedies, nor of proper medication for gastric and hepatic derangements, though electricity is certainly not without beneficial action in assisting the functions of the digestive organs. Dependence upon it alone is, however, a cause of disappointment in many cases, and the secret of failure to repeat the results of successful operators is often to be found in a torpid liver or neglected gastro-intestinal complication.

It should, therefore, be the first duty of the physician who is about to employ static electricity by general methods for its tonic or nutritional effects, to combine suitable and necessary medication to put the patient in a state to receive the full benefit of the influence for good that is exerted by electrization upon the nervous system, which in turn will then proceed to improve the whole body.

CHAPTER XXVII.

HOW TO PRODUCE SPECIAL THERAPEUTIC EFFECTS.

Method of obtaining general sedation effects with static electricity. Method of obtaining local sedation with the static breeze. Method of producing general stimulation effects. Varieties of technique. Effects of static stimulation not evanescent like alcohol. Not followed by depressing reaction. Invigorating properties of static electricity due to improvement of nerve and muscle nutrition. Method of producing local stimulation with the static breeze and spark. Special reference to polar selection in local applications. Both positive and negative forms of static breeze may be made sedative or stimulating by the operator. Remarks upon testing the static current for chemical effects which it does not appreciably possess. Counter-irritant applications. Different methods of producing rubefacient effects. Certain forms of application surpass all other methods of producing quick and effective counter-irritation. Nutritional applications of static electricity. Thorough constitutional effects in the treatment of chronic diseases. Muscle-contracting methods. A disruptive discharge required. Massage effects. Special methods described. Electrical and hand massage. Physiological effects of each. Therapeutic effects of each. Advantage of the Holtz apparatus in superseding the ordinary *masseur* in office practice.

WHEN no local application is required and a **general sedative-tonic** effect is sought the patient should be charged positively rather than negatively. The effects, sedative and stimulating, are relative expressions of the same constant and chief action of the static charge as a function-regulator. The effect of regulating a state of circulatory or nervous excitement is called sedative, and the effect of restoring to normal a state of under-activity may be called tonic or stimulating, but both results are the effect of the one regulating tendency of the static current and cannot be produced unless the patient is in the susceptible or opposite state.

The author's method of positive potential alternation acts even more quickly and powerfully as a sedative. I prefer the

positive to the negative charge because I believe it to be more energetic in its action. I do not attribute any chemical difference to the two polarities. As long ago as 1781, and previous to that time, it was fully ascertained that: "by electrization, *whether positive or negative*, the pulse of a person is quickened, the number of pulsations being generally increased about one-sixth; and that glandular secretions and the insensible perspiration are promoted and often restored when they had been entirely obstructed."

I conclude that when a patient is seated upon the static platform and charged from the negative prime conductor the difference of potential between the charge and zero is very much less than the difference of potential between the positive charge and zero.

As the greater difference of potential represents a greater pressure force, and consequently a greater rate of change, I conclude that it is to this extent more effective in accomplishing certain results within the tissues; and as a matter of fact this judgment is corroborated by clinical experience.

Granted that the therapeutic work of both poles is in the same direction, it is evident that the polarity which produces the most active rate of current flow under the conditions of insulation, accumulation, condensation, and atmospheric diffusion will be the most active therapeutically. It is my custom, therefore, to employ the positive pole for general sedative effects in almost all cases.

Local Sedation with the Static Breeze.—To secure this effect in acute local congestions, irritable states, pruritus, dermatitis, tender and swollen joints, acute sprains and injuries, the insulation may be negative, the breeze positive, and the patient should receive the breeze directly upon the uncovered skin of the affected part.

Seat the patient on the negative platform; ground the positive pole and the brass point electrode to the gas fixture or water pipe. With the plates in moderate action keep the point

in gentle movement over and around the affected surface and beyond sparking distance if congestion or inflammation is present, for sparks should not be applied to these states.

The distance at which the electrode should be manœuvred should be such as to produce the most cooling and beneficial effect, and experience must teach this to the operator. Relief is almost instantaneous and is continuous while the breeze is passing, but to be made as permanent as possible the application should continue about double the length of time required to produce a sense of relief after the breeze is stopped.

The length of the *séance* varies in actual practice from five to ten minutes in mild cases to fifteen or even twenty minutes in more severe or very obstinate cases. This form of sedation is applicable to almost any external part of the body, and in addition to being exceedingly useful as a local sedative it produces a general tonic effect upon the entire system.

General Stimulation Effects.—The effects of static application are very much more in the nature of nutritional tonic action than of mere stimulation. I have had patients report to me that their family physician laughed at the idea of their being benefited by static electricity, and told them that it was only a "temporary stimulant like alcohol," and that "a drink of whiskey would do about as much good." The gross ignorance of facts a century old betrayed by such commonplace assertions will apparently never be educated out of the medical profession so long as medical colleges trifle with the great subject of electro-therapeutics.

If a patient is in such a state that what may be called a general stimulation of the circulatory and muscular systems is indicated, it may be obtained in any one of several ways.

A general application of a Leyden-jar current to the surface of the body will do it. Ten or fifteen minutes of simple positive electrification will do it in the mildest degree. A positive breeze to the spine with negative electrification will do it still more perceptibly.

If fusillades of sparks are thrown from the brass point to mingle with the spray application the effect will be still further increased. If the platform is again connected with the positive pole and the spinal breeze applied from a grounded brass point electrode the stimulating effect will be intensified in direct proportion to the power of the current, the proximity of the electrode, and the resistance of the wearing apparel.

If sparks are also discharged with the breeze the rate of change and consequent stimulation will be increased. If the electrode is rubbed over the surface instead of being swayed at a distance, greater or less, the stimulation will pass into a decided counter-irritant effect.

Efficient muscular stimulation is obtained by any application that will contract the muscles. The mild positive spark with negative electrification produces contractions which are proportioned to the spark length and thickness, regulated by increasing or decreasing the revolution of the plates.

With positive electrification the spark from the grounded brass ball electrode discharges the patient with a still greater difference of potential, and the increased voltage gives to the spark more pungent, stinging, penetrating, heating, and stimulating properties.

None of these effects are, however, of the nature of an alcoholic stimulation, which is evanescent and followed by depressing reaction. They are more nearly comparable with the enduring vigor imparted to the tired system by a restful and substantial meal. The great basis of value of static electricity is a nutritional, rather than a merely stimulating effect. No one need remain uninformed of the truths of electrophysiology.

Local Stimulation with the Static Breeze and Spark.—Every localized application of static electricity in any form tends to stimulate the normal function of the part. The action of remedies is to some extent regulated by the existing conditions within the patient. A hypodermic injection of a grain

of morphine would be but a gentle comforter to the victim of a cancer who is habituated to its use in such doses. It would act as a stimulant to restore the normal sense of well-being and cause no effects of narcotism.

The effect of the same administration to a person either sick or well who had never taken a dose of morphine in his life would be of a very contrary nature. To some extent, therefore, the same applications of static electricity which soothe pain, congestion, and inflammation in these overactive states are stimulating to the opposite condition; but the most direct and effective stimulation to any local part is secured by exercising the muscle functions.

What is said above in the remarks upon general stimulation sufficiently covers this ground. I shall, however, dwell for a moment upon the subject of static polarity.

Very confusing ideas are prevalent among physicians on this point; some considering that the choice of poles relates to chemical action, so that they must be as carefully differentiated as when employing the electrolytic action of the opposite galvanic poles; some holding the view that having successfully cured a case by the masterly selection of the proper pole, they would have aggravated the condition if they had employed the other; and some considering the whole matter as hopelessly tangled in confusion and ignorance and yet awaiting the conclusions of scientific inquiry.

These views may all be brushed aside. A careful reading of the chapter on electro-physiology and the actions of different administrations will show that all that need be known on these points was pretty fully ascertained when Cavallo wrote of static electricity one hundred and twenty years ago.

It is universally stated that the positive breeze is sedative and the negative stimulating. By negative breeze is meant the application from a grounded electrode, with the negative pole grounded and the patient connected with the positive prime conductor. For the sake of simplicity, and to avoid mixing up

the teachings upon the subject, this book follows the usual statements in this regard.

As a matter of fact, however, it cannot be repeated too often or made too plain that the nature and effects of all breeze applications with either pole depend a great deal on the operator. I will now state that there is no more sedative application possible with the brass point electrode than the so-called "negative breeze," if I desire to make it so. Far from being "stimulating" and "irritating," it can be made to play like the cool zephyr of an ideal spring upon a heated and painful part, or any part wherein resides an ache or sense of irritation; and the two conditions which are all that are required to produce this most exquisite and refreshing of static sedative applications are non-resistance between the surface of the body and the point of the electrode, save only the air gap; and the reduction of the latter to about two inches—or, if the machine is in rapid motion, three or four inches.

This application, which is so delightful upon the absolutely bare skin, is also exquisitely agreeable through cotton fabrics and some of the lighter materials which ladies wear in the warm season of the year. It is the presence of thick hair upon the scalp and the resistance of woollen or winter garments which alone give rise to the prevailing idea regarding the negative breeze.

Physicians who are just beginning their experience with static electricity and who imagine that polar effects are chemical in their nature, may either read the long-established facts or inform themselves by a few simple experiments.

Polish two pieces of copper wire and attach to the tips of a pair of conducting cords. With a hard-boiled egg, a piece of raw beef, and three small dishes, one containing a ten-per-cent solution of salt, a second a ten-per-cent solution of iodide of potassium in starch, and a third plain water, determine what chemical effects really follow when the pieces of copper wire are in turn thrust into the egg, then into the beef, and then into

each of the solutions, and a continuous galvanic current of any given amperage passed for any desired length of time.

The copper wire should be polished between each experiment, and, beginning with a large current which will produce immediate chemical effects, the physician should reduce the current to discover how small a number of milliamperes is required to permit a brightly polished positive copper needle to remain in a hard-boiled egg for one hour without causing the slightest green discoloration.

Having obtained in this manner some idea of what takes place, repeat the same experiments with the static current. No further argument will be required.

Counter-Irritant Applications. — Local counter-irritation may be effectively applied with superficial and reflex effects by the static operator. It is one of the best, if not the very best, means of influencing the deeper tissues through the cuticle; and it acts almost instantaneously.

Its reflex actions are all the more pronounced because of the fact that every local application is accompanied by an impression for good upon the general system.

Local applications made with the low-potential pole connected with the platform involve a reduced voltage and are therefore less rubefacient in their effects. Those made with the pole of higher voltage effect a much more rapid rate of change and are therefore more intense and can be made more effectively counter-irritant. The principle being exactly the same whether the patient is insulated with the negative or the positive pole, I shall consider only the latter.

Seat or stand the patient upon the static platform with direct metallic connection to the positive pole. Any and all electrodes may be employed and the effect of each is modified (if it is wood) because it is a poor conductor, and increased (if it is metal) by its better-conducting properties, and by its size, shape, and method of manipulation.

The electrode selected is grounded to the gas fixture along

with the negative pole. Start the machine into action. The spine, joint, or local area to be treated should be covered with fabric of texture which will resist the current, such as coarsely woven woollen goods, mohair, silk, etc. If the patient is not so clothed it is a simple matter to throw a piece of fabric kept for this purpose over the part.

I will first refer to the use of the brass point electrode. With the machine in fairly rapid action throw upon the part a succession of showers of needle spray. If the electrode is rapidly withdrawn to some distance, and is swept up and down, or thrown toward the part only at intervals which permit intercurrent relief from the sharp sensation, the application is acceptable to the patient's tolerance.

It can be made more vigorous or milder by increasing or reducing the speed of the machine, and by concentrating or diffusing the spray. The sharp, biting discharge should not be continuously forced upon the tissues by holding the electrode still and at a short distance. Two or three minutes suffice to obtain the desired effects.

In employing the grounded brass point electrode with positive high-potential electrification the operator should personally become acquainted with the differences in sensation, stimulation, and irritation produced by throwing the point directly toward the tissues, by short strokes up and down or from side to side, by long sweeping strokes, by rapid and slower movements, and by holding the point still, at greater or less distances.

Manipulation alters the effect and there is a good deal of knack about it. The addition of volleys of sparks thrown like a fiery trail in the wake of the spray intensifies the effect.

The usual sparks with negative electrification are also counter-irritant, but in a much milder degree than sparks applied in the following manner:

Connect the platform with the positive pole, and ground the negative pole and brass ball electrode or massage roller or even

the brass point to the same gas fixture. Any electrode with a metal surface may be employed. With the machine in mild, or medium, or rapid action, according to the intensity of the heating and rubefacient effects desired, quickly advance the electrode to contact with the surface of the body and rub it over the clothing with rapid passes, maintained only for the brief time that the patient can endure the biting sensation, and then withdraw the electrode.

These hot and irritant frictions can be repeated a number of times within a couple of minutes.

The long splitting, stinging spark with the electrode connected to the negative pole while the patient is electrified positively is also powerfully counter-irritant as well as muscle-contracting.

The uses of these several means of producing counter-irritation cannot be itemized here. The practical physician will recognize when such effects will be appropriate to a given case, and it is only necessary to have in mind the technique of grading local action.

Vesication can, of course, be produced by simply pushing the application to intenser effects, but he who makes much use of static electricity soon learns to prefer milder measures and practically abandons vesication, blisters, cupping, and similar procedures which are more annoying to the patient and vastly less efficacious than the simple and beautiful resources of electro-therapeutics.

Nutritional Applications.—When the chief aim of the static administrations is to promote the general nutrition a useful starting-point is made by every form of either local or general treatment that can be applied. However, general positive electrification produces a more active rate of change within the tissues than general negative electrification, because its voltage is higher and it more readily overcomes the resistance of the insulating atmosphere and diffuses out of the patient with greater energy.

Any form of local application that is familiarly employed to improve the functions and nutrition of a part can be extended over the general surface of the body to improve the functions and nutrition of the whole system.

The static-cage application and potential alternation are excellent nutritional methods. In many cases we are content to add to general positive electrification a localized breeze upon the great nerve centres of the head and spine which influence the functions of the body.

In other cases of chronic disease with lessened sensitiveness and great tolerance of the spark I depend for the best nutritional effects upon three or four minutes spent at the close of the sitting in the application of medium sparks up and down the spine, over the great organs of the trunk and the muscle groups of the extremities, in fact to the general surface of the body below the head.

Muscle-Contracting Methods.—It requires some form of disruptive discharge or interruption of the static current to produce a muscular contraction. Leyden-jar currents with either rapid or slow interruption represent for this purpose the equivalent of induction-coil currents.

Static sparks of every degree contract muscles to which they are applied, and most powerfully so when they strike the motor point. The massage roller contracts the muscles over which it is passed. An additional method consists in having the patient hold an electrode by its hard-rubber handle and press the metallic end upon the part to be treated. With the brass ball electrode the operator applies a slow succession of sparks to any portion of the metallic surface of the electrode held by the patient. This does away with the sting of the spark directly upon the tissues, and is available in some regions whose anatomy is not adapted to sparks in the usual way, and especially if the patient is sensitive.

When a hand or arm is the part to be treated, a chain may be wound around the upper arm, or forearm, or hand, and

hooked upon either pole of the machine, serving as the platform connection. The other pole is grounded, and with the grounded brass ball electrode slow interruptions of the current are produced by sparks between the electrodes and the prime conductor to which the chain is attached. If this is the negative pole, the current will be less vigorous and the contractions milder than if it is the positive pole. The vigor of the contractions is also regulated by the speed of the machine.

If the hand is immersed in a jar of water, and connected with the prime conductor of the machine by dropping the tip of an ordinary cord into the water, the sparks upon either the sliding pole of the machine or any part of the patient's body will exercise the arm from the finger-tips to the shoulder.

Massage, Electrical and Hand.—In some degree every form of electrical application with an interrupted current which produces a muscular contraction is massage. The muscular contraction of the static spark constitutes a very powerful form of massage.

The application of the roller electrode is so similar in principle to massage that it has long been called the massage roller. The application of Leyden-jar currents to the surface of the body as in general faradization constitutes a very thorough and efficient form of massage.

Rapidly interrupted high-potential currents produce a vibratory action within the tissues for which there is no counterpart in manual massage, and the author's method of potential alternation involves a fine bombardment of the nervous system of a kind and degree which the hand of the masseur is inadequate to produce.

The effects of massage are local and systemic. The physiological effects are succinctly stated by Bartholow: "The masseur puts forth more or less muscular power, which at the points of friction develop another mode of motion—heat. The action thus induced in the tissues elevates the temperature; the vessels dilate and an increased quantity of blood enters them,

and the motion of the blood current is accelerated. The immediate effects of these changes is to promote the nutritive energy of the tissues subjected to friction. This result is seen in the improved color, warmth, and volume of the parts. A general rise of temperature averaging about one degree takes place quite uniformly. The body increases in weight; all the organic functions are performed with more energy, and power is gained in every way.

"Massage in its several forms exercises peculiar effects on the nervous system. When an inflamed part, such as a joint which can be manipulated, is rubbed with excessive gentleness, the sensibility, which was at first so acute that every touch gave pain, readily subsides, until, after an hour of friction, it may be handled with some roughness without evoking painful sensation. The state of spasm of a muscle is relieved and relaxation induced by persevering rubbing of the affected muscle.

"Therapeutically massage is employed in wakefulness and nocturnal restlessness, simple headache, neuralgia, hemicrania, migraine, spinal pain, paralysis, progressive muscular atrophy, chronic joint affections, synovitis, contractions and deformities, thickening from inflammatory deposits, neurasthenia, anæmia, hysteria, constipation, rheumatism, etc."

While speaking of the extraordinary utility of massage in certain cases Bartholow also states that "patient and long-continued use of the method may often be required."

The confidence of the medical profession in massage is very great. It is in good repute among the laity. Its merits are usually set forth by those who pursue the vocation of rubbing people in about the following manner:

Massage is a scientific mode of systematic manipulations upon the nude skin of the human body in a passive condition. It includes percussion, friction, kneading of the muscles, exercising the joints. The physiological effects of massage include the incitement of the nerve centres, a healthy rise of temperature, acceleration of the blood current to the arterioles, promotion of constructive metamorphosis and the nutrition of tissues; also destructive metamorphosis,

excretion of waste substances and a general increase of muscular force.

Its effects upon the nervous system are soothing; and by skilful, gentle manipulation the acutest pains gradually depart. Under the treatment of a scientific operator morbid mental states give place to hope and cheerfulness and all the functions of the body are performed with increased energy, causing those benefited by massage to say: "*Life is worth living.*" The most eminent physicians in Europe and in America give massage a prominent place among topical health-restoring agents and highly recommend it as a valuable therapeutic auxiliary. Therapeutically massage is beneficial in the treatment of . . . and similar diseases.

Sufferers from obesity have been greatly benefited and their weight reduced by massage. For weak and sickly children also suffering from infantile paralysis massage is the best topical remedial agent. Persons who are free from organic or symptomatic disease, but are deprived of outdoor exercise, including clergymen, lawyers, and all whose brains are overtaxed will find the soothing manipulations of a skilful operator a mental and physical luxury.

No one who will study the physiological action and witness the therapeutic effects of galvanic, faradic, and static currents of electricity, in the great variety of local and general methods by which they may be administered, with their wide range of exact dose regulation, will fail to see that every demonstrated influence of massage upon the human tissues is included within the compass of electro-therapeutics; and the skilled operator with fine apparatus can so far surpass the manipulations of the hand that all that can be claimed for massage simply demonstrates the superiority of electric current action.

Referring especially to the ordinary applications of static electricity for exactly the same long list of diseased conditions for which massage is recommended, it may be said of massage that it is not usually performed by the physician, but involves putting the patient into the hands of a third party, who is often destitute of medical education, but who fills the ear of the patient with attractive stories and takes all of his money that he can get. On the part of the patient it involves disrobing, and the sacrifice of about an hour's time for each *séance*, and the

development of effects by a slow and tedious process. In the case of pain and acute inflammation of a joint a good operator will succeed slowly at best, while a poor operator can easily make matters worse.

The applications of static electricity are made by the physician himself. He keeps his patient in his own charge without outside interference. The patient is not required to disrobe, and the treatment occupies only from five to fifteen minutes.

Symptomatic relief, especially relief from pain, is obtained in a manner as much superior to the processes of massage as the electric light is ahead of the old wax candle.

Massage cannot by any possibility do any good to the patient that static electricity cannot equal or surpass.

Static electricity can do much for many patients that no *masseur* has ever dreamed of accomplishing. However, it is equally true of both massage and the static machine, that each requires an experienced and competent operator; and if the patient is confined to his room and is neither able to visit the physician's office nor enter a well-equipped sanitarium, the *masseur* can reach him and do him good while the static machine cannot.*

* Much of the best electro-therapeutic work in medical practice depends upon non-portable apparatus for its accomplishment. Physicians and surgeons who are completely equipped with improved static, galvanic, and high-tension induction-coil apparatus will do much to extend their usefulness by receiving patients into their residence if they are not in sanitarium work. In this way many cases may obtain the benefits of frequent and thorough treatment who would otherwise be deprived of relief. This has been the author's practice for a number of years and possesses advantages in favor of both the medical attendant and the invalid. I am certain that in some of my cases more benefit has been given them in a month by having them in my house than they could have obtained in six months by attempts at even similar treatment if daily journeys to and from the office had been undertaken.

CHAPTER XXVIII.

DISEASES OF THE SKIN.

The place of static electricity in their treatment. Its value for the relief of symptoms and to promote nutrition. The importance of improving the general health in the treatment of skin diseases. The relief of itching, burning, and painful symptoms by static electricity. The class of cases to which it is suited. Falling of the hair from debility or defective nutrition of the scalp. Method of treatment. Effects. Alopecia. Indications for static electricity found in the constitutional state of the patient. Local and general benefits of electrification. Acne. Static electricity useful to promote systemic nutrition. Its influence upon the causes of acne. An efficient auxiliary aid to treatment. Local anæsthesias. Anhidrosis. Carbuncle. A clinical case. Dermatalgia. Static electricity relieves the symptom and treats the cause. Dermatitis. Beneficial action of the sedative breeze in acute inflammations of the skin. Eczema. Symptoms and causes indicate static electricity. Principles of successful treatment of eczema with static electricity. Elephantiasis. Probable relief of symptoms by static sparks. Epithelioma. Temporary relief of pain by the static breeze. Erysipelas.

STATIC electricity is not a panacea for cutaneous affections and probably the dermatologist would be one of the last men in medicine to consider a static machine as part of his office equipment.

But for the general practitioner who is called upon to treat a great many of the simpler and more curable cases it is worth while to consider how he may employ an apparatus for which he has paid a large sum and which will render him and his patients services of very great value.

Static electricity cannot take the place of cleanliness, the evacuation of pus, surgical measures, mercury, sulphur, carbolic acid, etc., but it is useful for the relief of some symptoms and to promote the general and local health.

One of the most practical recent writers upon dermatology says:

> Every patient should be regarded as out of health in some way quite apart from his skin trouble, and examined as to the performance of all his functions quite as carefully as if he had come to you for the treatment of some internal disorder.

The same writer also says in regard to new remedies, some of which appear nearly every month, that

> careful comparative tests demonstrate that many of them are no better than the old and tried ones. It is better for the general practitioner to learn how to use a few drugs than to try every new thing.
>
> By practical experience he will be surprised to see how much he can accomplish with a very small assortment of drugs. The greatest secret in the treatment of eczema and many other skin diseases is not what particular drug or formula is good for the disease, but a knowledge of the great principle that acute diseases need soothing remedies, and subacute and chronic diseases need stimulation.

If the physician will turn from this statement by a very competent dermatologist and read afresh the chapter of this book which describes the local and general sedative, tonic, stimulating, counter-irritant, and nutritional action of the different forms of static administration, it will appear plain that this agent is a substitute for some part of the routine treatment of skin diseases in a great many cases, and that in some cases it will produce benefits to the patient which cannot be obtained so well in any other way.

For the relief of itching, burning, and painful symptoms it surpasses any palliative known to me, and I have tested a very large number.

If we consider skin diseases without the myriad subdivisions which enter into the description and diagnosis in classical works on this subject, and regard them as either functional or organic, and apply principles of treatment with regard both to the cause and the pathology of the lesion, and still further eliminate the lesions which fill the pages of literature but are

rarely seen in private practice, we get down to a working basis for the application of static electricity.

In the following remarks I have drawn freely from the writings of Dr. George Thomas Jackson, who in turn acknowledges his indebtedness to Crocker, Fox, and other leading workers in the field of modern dermatology.

Falling of the Hair from Debility or Defective Nutrition of the Scalp.—Seat the patient upon the static platform in the usual manner, and if the hair is thin and the current is not irritating, or if the irritation can be satisfactorily removed by interrupting the breeze, apply a strong negative head breeze for about ten minutes every second day.

The platform should be connected with the positive pole, and the grounding chain attached at the same time both to the negative pole and to the breeze electrode.

If there is some soreness of the scalp, or if the hair is thick, or if for any other reason the application must be made milder out of regard for the comfort of the patient, the head breeze must be connected with the positive pole and the platform to the negative.

If the patient's health is below par other tonic applications to the spine and general surface may be applied as indicated.

It is a matter of common observation that patients undergoing a course of treatment with static electricity for some other chronic affection notice that their hair ceases to fall out, and as the general nutrition improves in a couple of months' time the nutrition of the scalp has also been improved.

Clinical Remarks.—Dandruff is said to be the most frequent cause of premature baldness, and dyspepsia is not only one of the most common diseases but is probably also one of the most common explanations of the loss of hair. The nutrition and proper blood supply of the vital organs is the first consideration of nature. When she cannot command a sufficient quantity of circulating nutrition for all parts of the body she retrenches at

the extremities and cuts off the supply first from parts which are the least vital, like the hair and the nails.

The reader who studies the effects of static electricity upon the general circulation and nutrition will note that it is definitely indicated in these cases.

Alopecia.—Some forms of this condition are far beyond the reach of any remedy, and others are amenable to specific medication, but the neuralgic pains of alopecia areata may be relieved by the static breeze, and the fact that the disease has a strong tendency to spontaneous recovery in the course of time would suggest the probability that static applications might aid nature a good deal; especially when the patients are "of a very nervous temperament, exhausted by overwork or nervous strain, or are out of health in some way."

If the neurotic theory of the disease is correct it would be an additional reason for employing electricity. Jackson especially says: "One duty we have without peradventure, and that is, to look after the general condition of the patient. A large number of the cases require a stimulating and tonic treatment —iron, quinine, strychnine, arsenic, cod-liver oil, or hypophosphites. Children should be allowed to run free and taken out of school. Our hardest task will be to manage those nervous patients who are ever a trouble to us." This certainly calls for static electricity with a loud voice.

This is apart from the local treatment, which is summed up in two words, "patience and stimulation"; but the general indications for static electricity could not be more clearly stated than they are stated above by the dermatologist who had no thought of such an agent in his mind.

The nervous patients who are ever a trouble to the dermatologist are particularly amenable to relief by skilful static administrations, which are as welcome to them as shade to the traveller in the desert.

Acne.—In these cases static electricity may be useful to

promote the systemic nutrition of the patient rather than locally to treat the sebaceous glands.

It may be stated as a broad general rule that anything which lowers the general health of the patient contributes to the production of acne. Thus, we have the vague state "general debility," anæmia and chlorosis, oxaluria and uræmia, rheumatism and gout, poor circulation, bad personal hygiene, mental and physical exhaustion, and chronic malaria, cited as causes by writers upon dermatology.

These are all the particular conditions which general static electrification influences favorably, as may be seen by reference to the chapter on its physiology.

Of treatment Jackson says: "In the treatment of acne we can obtain a cure most surely by attention to the general condition of the patient; most rapidly by a combination of internal and local treatment; and we should therefore begin the treatment of a case by careful inquiry into the general condition of the patient, and endeavor to regulate any, even the slightest, derangement of the internal organs."

The thorough treatment of these cases therefore involves the local measures usually employed, the regulation of diet and hygiene, and the application of the principles of general medicine to the relief of constitutional disorders.

Static electricity will be found an efficient aid to the constitutional part of the treatment.

Anæsthesia.—This is a loss of sensation in the skin which occurs in a number of diseases of the nervous system, notably in hysterical affections. It may be general or partial, and is probably more successfully treated by static stimulation of the sensory nerves with either short friction sparks or long sparks than by any other means.

Anhidrosis.—This symptom may be local or general, and depend upon a number of causes, but when it is neurotic the restoration of the function of the sweat glands is directly in line with the physiological actions of static electricity.

The usual treatment recommended is "tonic exercise and bathing," and it is evident that the capabilities of static electricity far surpass either of these measures. It can be added to them with good effect.

Carbuncle.—Apart from surgical measures Jackson says: "As the disease is an exhausting one, the patient's strength is to be supported from the start, and his nutrition kept up by a generous diet. Fresh air by good ventilation must be secured. If the pain is excessive, opium or morphine is indicated especially to secure sleep. Iron is a valuable remedy all the way through, and quinine or antipyrin if the fever is marked. Alcohol should be given if suppuration is free, especially if there are any signs of exhaustion."

The author has had no experience in the treatment of carbuncle by static electricity as a supplementary measure, but the following case was reported by Harper in April, 1893:

On November 10th last a gentleman called at my office suffering greatly from effects of a carbuncle at least three inches in diameter and thoroughly honeycombed, on the side of his neck. During several nights he had not been able to sleep.

I at once made a crucial incision to the full extent and depth of the morbid mass, and then applied a static breeze which favored the free flow of pus and relieved all pain.

The following day the patient asserted that he had slept all night, had a good appetite, and had not suffered a twinge of pain since he left my office.

On the fourth day, with the aid of small forceps, I drew out all morbid material, which was of so firm a character that some pieces were one and one-half inches long and it was necessary to cut them loose from the bottom.

On the following day it occurred to me that I might bring about adhesion of the four flaps instead of allowing them to slough away. Accordingly, I strapped them down tight and drew sparks from the surface.

On the next day half their extent was adherent, and in twenty-four hours more full adhesion had taken place, leaving only a scar as from an ordinary incision.

The patient never lost a meal from the time of his first treat-

ment, could lie sleeping on the affected side, and had no recurrence of any pain whatever. Having heretofore seen severe and prolonged suffering from carbuncles, I desire to report the results in the above case.

Dermatalgia.—This neurosis may disappear of itself "after weeks or months." The pain is variously described by patients as boring, pricking, or burning; or numbness or coldness may be complained of. It may be constant or intermittent in character and is sometimes so severe as to be agonizing. The symptomatic form occurs in locomotor ataxia, rheumatism, syphilis, malaria, diabetes, hysteria, chlorosis, and about the menopause.

Treatment: "If we can remove the underlying cause we can cure the trouble, so our remedies should be first addressed to it. Unfortunately, for some of the diseases of which dermatalgia is a symptom we can do little. In any case, the patient demands some local treatment to relieve the pain."

Of the score of remedies suggested by the writer of the above paragraph every one of them is distinctly inferior to the best and simplest remedy which he does not name.

The capabilities of relief by static applications varying from the positive or negative breeze to the spray and spark, according to the situation and extent of the dermatalgia, not only include the immediate cessation of pain at the first sitting, which lasts for a longer and longer time as the sittings are repeated until in many cases it becomes reasonably permanent, or in incurable cases is reasonably palliated, but far beyond the affected area of the skin the reflex and constitutional benefits of static electrification exercise a beneficial influence upon almost every one of the important diseases of which the pain is symptomatic.

Whatever special medications may be indicated by the presence of rheumatism, syphilis, malaria, diabetes, and chlorosis, it is certain that static electricity will increase the benefit they produce upon the general system, and it is the most effectual

local remedy that can be applied to the site of pain. Daily and long sittings are advisable if the case is stubborn, and more dependence should be placed on the negative breeze than on sparks.

Dermatitis.—While nearly every case of dermatitis will naturally be treated by ordinary methods, yet it has occurred in my own experience that on the first visit of the patient to the office and before applying any local dressing, it has been worth while to treat the part with a sedative static breeze.

By this means the relief of pain is instantaneous while the breeze is passing, swelling is reduced, the intensity of the inflammation is lessened, and severer symptoms are cut short. In fact the comfort of patients has been so agreeably promoted that they have expressed very lively appreciation.

One advantage in addition is the abatement of constitutional disturbances through the sedative and restorative action of the general electrification upon which the breeze is engrafted. In later stages when itching is a marked feature the breeze also relieves this. It must be applied upon the bare skin.

In the many forms of chronic dermatitis the static breeze will be found an excellent palliative to the symptoms and an effective means of applying local sedation or stimulation, whichever may be needed.

Eczema.—It has been said that the physician who learns to recognize and treat syphilis and eczema has in his possession the key to the whole of dermatology.

There are six prominent symptoms of this inflammatory and frequent skin disease: redness, itching, infiltration, tendency to moisture, crusting or scaling, and cracking of the skin. The subjective symptoms are itching, burning, and a feeling of heat and tension.

About twenty-five varieties of eczema are described. Some of them last a few years and some of them last forever, with occasional vacations.

Of the predisposing causes the most universal and active is

some disturbance of digestion, constipation, malassimilation, perverted nutrition, derangement of the liver. At other times the kidneys are at fault. Diabetes and Bright's disease both predispose to eczema. Chlorosis and anæmia, uterine disorders and the menopause, and the strumous diathesis are at times active factors. Derangements of the nervous system are exciting causes; now and again we will meet with cases which appear suddenly after some nervous shock. Rheumatism and gout and varicose veins are other predisposing causes.

To most of these internal causes some external cause must be added before the eczema appears, and the external irritants are about the same things which will cause a dermatitis, "only the action goes further and a catarrhal condition results."

As this is the dermatosis which the practitioner is most often called upon to treat, and as chronic cases are exceedingly stubborn and return again and again after temporary "cures," and the remedies are countless, it is well to have in mind a condensed synopsis of the chief principles of treatment.

Regarding the patient as a sick man it is obvious that constitutional measures which will improve the powers of nutrition, correct disease, and regulate functions are indicated.

Whatever else may be prescribed for the general condition, there is no internal prescription which will "cure eczema," but there are two measures supplementary to diet, hygiene, and indicated medication which are of very great value. These measures are the most nearly curative of any known to the writer, and the *rationale* of their action can better be appreciated by first reading a description of the causes of eczema and then reading the physiological effects of the galvanic and static currents.

I believe central galvanization to be the nearest approach to the best single constitutional remedy that can be employed, but the nutritional properties of general static electrification are also of considerable value.

It is, however, as a local relief to the itching and other

symptoms and as a means of applying local sedation or stimulation, whichever may be needed, that static electricity possesses a very great value as an auxiliary to central galvanization.

The principles of local treatment laid down by writers are: "In acute cases employ soothing remedies; in subacute cases use astringent and slightly stimulating remedies; in chronic cases stimulate; in all cases protect the skin from external irritation."

The use of water is generally advised only in chronic cases, and in such cases I have obtained the best results by making the galvanic application within an electro-thermal bath cabinet, after which I have made the static administrations at the same sitting.

It should also be noted that while there are numerous conditions presented by patients with chronic eczema which seem to call for special medication, yet it has been my fortune to have patients give a history of long medical treatment with no practical benefit, and when I have treated them with galvanic and static currents and simple external measures for protection from irritation they have become quite comfortable in a short time and have progressed to an improvement directly in proportion to their perseverance in treatment.

Some have simply got better and stopped treatment, and some have continued longer and got more nearly well. In an ordinary case twenty treatments will produce results that would require a course of thirty or forty applications in a more obstinate or complicated condition.

In very simple and recent cases which present only a catarrhal condition, the local application of a spray mingled with fine sparks from the brass point electrode is often entirely adequate.

Elephantiasis.—This chronic disease is characterized by hyperplasia of the skin and subcutaneous tissues, due to a stoppage of the lymphatics, affecting chiefly the lower extremities, and marked by enormous enlargement of the affected part.

While the writer has of course had no opportunity actually to test the effects of static electricity upon this condition, yet it must occur to all who are familiar with the effects of static sparks that they would relieve the sense of weight, pressure, pain, and other symptoms with which the patient might be affected.

It is by no means necessary to estimate the remote possibilities of a cure in order to consider static electricity as likely to give relief to some part of the trouble and greatly promote the comfort of the patient.

Epithelioma.—The only possible utility of static electricity in cases of epithelioma might be the relief of the sharp pain which is sometimes present by the positive spray, either before or after operative measures.

Erysipelas.—If the patient is first seen at an office visit the subjective symptoms of burning, tingling, itching, tension, and pain may be greatly relieved in ten minutes by the application of a positive static spray and the patient may then be sent home with a greater degree of comfort than could be obtained by any other means. After appropriate treatment the period of convalescence may be shortened and renewed strength very quickly established by a few office visits for further tonic administrations of positive electrification and spray to the spine.

CHAPTER XXIX.

DISEASES OF THE SKIN, CONTINUED.

Boils and persistent furunculosis. Curative effects of static treatment. Herpes and herpes zoster. Value of static sedation in acute stage. Relief of burning, itching, and neuralgia. Value of static electricity in chronic and debilitated cases. Hyperæsthesia. A clinical case treated with static electricity. Hyperidrosis of the feet. Leucoderma. Negative results of treatment. Lupus. Indications for the general nutritional effects of static electricity after surgical measures. Pruritus. Static electricity the most successful remedy. Report of cases. Method of treatment. Psoriasis. Static electricity to improve the nutrition of the patient. Scrofuloderma. Indications for static electricity as an adjunct to medical treatment. Dandruff best treated by the static head-breeze. Varicose ulcers. Improvement of local nutrition by static sparks. Tenderness of the scalp. Chronic urticaria. Relief of itching and constitutional improvement. Remarks upon the general usefulness and limitations of static electricity in the treatment of cutaneous affections.

Boils.—In the case of the ordinary single acute boil for which local treatment is efficient, the only application of static electricity would be the sedation of pain by the positive breeze if circumstances made it convenient to employ it. The spark would also promote resolution if there was some induration after the discharge of pus.

My experience refers more particularly to the repeated crops of small boils which constitute the condition known as furunculosis.

Seat the patient upon the static platform connected with the negative pole of the apparatus, ground the positive pole and the brass ball electrode. With the machine in slow action apply a few single thick but mild sparks upon each individual lesion.

If it is a blind boil with no tendency to suppuration the

mass will be dispersed in a few days and may not need more than a single application. In such of the other *foci* as show a more acute inflammation the process of suppuration will be hastened.

These crops of boils are the kind which persist for months or even years if left untreated, and are often very obstinate under any kind of medical treatment. It is suggested that diabetes mellitus may sometimes be the cause, and of course if this disease exists it should receive attention. One of the best aids to diet and the usual treatment of diabetes is static electricity, but mild static sparks will dispose of these crops of boils in short order and without much apparent regard to the particular cause.

If the patient's general health is below par it would be advisable to continue nutritional static treatment for several weeks if it was needed, but the local symptom of deranged health will disappear promptly under the local sparks.

Herpes and Herpes Zoster.—The varieties of herpetic inflammations of the skin are marked by burning, stinging, or itching in the part and in the case of shingles by neuralgic pain in the nerve along whose course the eruption is about to appear.

The value of static electricity in these cases is found in the very great relief which the positive breeze and mild spark afford to the symptomatic disturbances.

In a severe case of herpes zoster the sedative application would need to be repeated daily during the period of greatest pain. I have seen patients express great satisfaction with the comfort afforded by static electricity, but do not know that it has any direct effect upon the course of the lesion in recent and favorable cases. It certainly, however, is a great benefit in old and debilitated cases and when recovery is not progressing as it should.

Hyperæsthesia.—The following case of chronic cutaneous

[illegible] by the author in the *Medical* [illegible]

[illegible] The [illegible] sensation was [illegible] the inner and lower extremities [illegible] had been persistently for [illegible] years it had [illegible] about 2 P.M. daily, as [illegible] could be worn [illegible] that the [illegible]. In [illegible] to attend to business, [illegible] and sit down to dessert [illegible] pressure [illegible] but slight contact [illegible] extreme aggravation.

[illegible] way indistinct [illegible] outward [illegible] I derived more than a [illegible] but with no better [illegible] predecessors from whom I [illegible]

[illegible] and static [illegible] The effect was grateful. He [illegible] minutes, following [illegible] from the brass point electrode to every part [illegible], followed by a thorough nutritional [illegible] to the spine and extremities.

[illegible] remaining dressed until seven or eight [illegible] In two weeks the relief was such that [illegible] compelled to retire before the usual hour.

He continued this treatment for a month and a half, during which he received twelve treatments at my office and then left the city for the summer. I was afterward informed that his improvement continued and that he had a satisfactory degree of comfort, but considered that he should have received more than double the amount of treatment before desisting.

Hyperidrosis of the Feet. When this symptom is reported by patients who are undergoing a course of static treatment I am in the habit of applying mild sparks to the feet, and as a rule these patients also have sparks to the spine and nerve centres. No special effect upon the sweating is usually noticed. If there is any improvement at all it is slow and gradual.

Jackson says that local treatment in many of these cases is as unsatisfactory as the constitutional treatment. Some of the local measures employed are undoubtedly detrimental to the health of the patient, but static electricity can do no possible harm even if it fails to yield any brilliant results. There is a remedy called silica which has cured more of these cases for me than anything else I have ever tried.

Leucoderma.—This consists in a disappearance of the pigment of the skin in circumscribed round or oval patches so that white areas are formed. It is probably a disturbance of nutrition. I am unable to discover that dermatology offers anything in the way of treatment. During the past winter I treated a case experimentally about three times a week for two months with negative results.

The application was negative electrification with needle sparks from the brass point electrode over the patches. The patient had experienced a partial sunstroke prior to the appearance of the spots, which had begun to be noticed about four years ago. At the time of coming to me her health was in a generally depraved state and she was not a very hopeful subject.

Lupus.—"As lupus is a tuberculous disease and sometimes is followed by tuberculosis of the lungs, care must be given to the general health of the patient and he must be placed in the best possible hygienic surroundings. His diet should be nutritious, and cod-liver oil, iron, and iodine should be given. But external treatment is of the greatest importance and the disease must be gotten rid of root and branch."

The indications for the general tonic nutritional effects of static electricity after the surgical treatment of lupus are sufficiently set forth in the above extract. Static will do good service here.

Pruritus.—Itching of the skin is a symptom common to a great variety of cutaneous affections and it is more or less permanently relieved by the positive or negative spray applied directly upon the uncovered skin. When the functional neu-

rosis called pruritus is encountered by the owner of the static machine, he can relieve it in about the same way.

No one with any medical experience requires any information about the ability of pruritus to render the patient's life unendurable and tempt him to suicide. It is one of the most accursed affections that can afflict a man who to all appearances is entirely well and able to attend to business.

There are two important facts about pruritus occurring as an idiopathic affection. One is that every remedy, either local or general, recommended in every text-book on dermatology, is liable to disappoint the patient and afford him either only temporary relief or none. The second fact is that static electricity will palliate the condition almost as certainly as lotions and ointments will not. The victim of this neurosis may start out with the hope of obtaining a cure, but he will in time learn to be exceedingly grateful for even a palliative that will make his burden endurable.

Leloir (1894) reports as follows:

> During the last two years I have employed the static current with the most unexpected results in about twenty-five cases of localized or general pruritus, the more tenacious of which had resisted all treatment. A good number of cases of the extremities, vulva, and anus were cured after a variable number of applications. The eczematous or lichenoid condition secondary to the pruritus disappeared.
>
> In a certain number of cases the pruritus was relieved considerably but did not entirely disappear. In some cases the pruritus resisted all treatment.
>
> I have obtained analogous results in the treatment of generalized pruritus, but the results have not been so good as in localized cases. This method is of great service in rebellious cases of cutaneous pruritus.

My own experience in the treatment of this affection began with a case of inveterate pruritus of the scrotum in the summer of 1893. Whatever may be the part affected, the principle of the static application is the same.

Seat the patient upon the platform connected with the nega-

tive pole of the machine, ground the positive pole and the brass point electrode. The part must be exposed to the skin for treatment and the best effects will not be obtained if the spray is applied through the clothing.

Start the machine into moderate action and sweep the point near enough to the part to produce a luminous discharge of the spray. Gradually intersperse with the spray a few sparks and repeat them at momentary intervals. The spark must be applied with sufficient vigor to set up considerable irritation and reflex action, and for the moment may intensely aggravate the itching. After about three minutes devoted to this part of the treatment proceed to secure the utmost sedation possible by the application of the positive spray without any disruptive discharges. Persist in the soothing spray for about ten minutes.

Treatment may be repeated with reference to the urgency of the case. After some improvement is effected three times a week until benefit ceases will be sufficient, and if temporary aggravations recur in the future the same method will again be satisfactory.

In very annoying and obstinate cases of pruritus of the anal mucous membrane the static application cannot be so well applied, nor with such marked relief as in more convenient situations, and these may be treated by light applications of cupric electrolysis or the cautery, or any other method that will do any good.

Psoriasis.—The usefulness of static electricity in this disease of the skin will depend upon the state of the patient. If he or she is rheumatic or gouty or neurasthenic, or has pains and pruritic symptoms, or presents any lowered condition of general health, the indications for agents which improve the nutrition are about the same as if the psoriasis was absent. It must be applied according to the local and general indications of the individual patient.

Scrofuloderma.—Patients with these lesions are mostly young subjects, flabby of flesh, with pasty or doughy complex-

tions, a marked tendency to chronic catarrhal inflammations of all the mucous membranes, chains of enlarged glands in the neck, and perhaps some old or present bone lesions.

They are often dull and apathetic and certainly stand in need of vigorous static nutritional stimulation. The ulcers may be treated upon ordinary surgical principles. The regulation of the diet and hygiene of the patient and the administration of cod liver oil, iron, the hypophosphites, or other tonics is the most essential part of the medicinal treatment.

Those who study the nutritional effects of static electricity will desire to add this agent to the above and will feel that full justice is hardly done the patient who is not afforded the benefits of static electricity in addition to cod liver oil and the hypophosphites.

Dandruff. Seat the patient upon the static platform and conduct the treatment upon exactly the same lines described for premature loss of hair. The hygiene of the scalp should be of course sensible and simple. The scalp and hair do not need to be washed any oftener than once a week, and those who feel no irritation during longer intervals find once in two or three weeks often enough. Simple tar soap is good. The habits of using ammonia and borax, pomades, hair washes, hair tonics, and of sousing the hair daily are injurious.

For the treatment both of alopecia and of dandruff, general tonic measures, outdoor exercise, and hygiene directed to keeping the patient in the best possible condition so that the nourishment circulating in the blood will reach the extremities, are nearly always indicated even though the patient may think he is perfectly well. The nutritional results sought for are obtained most readily by general and local static electrification.

Varicose Ulcers. In the treatment of these conditions sedation of pain and other distressing symptoms may be effected by the positive breeze and mild sparks, and local nutrition and circulation may be greatly improved by sparks which may be administered through the dressing. After the ulcer has healed

the tonicity of the vascular walls and muscular tissues may be immensely improved by the tonic action of static sparks, and the recurrence of ulceration in the future may thus be prevented.

Tenderness of the Scalp.—Seat the patient upon the static platform connected with the negative pole. Ground the positive pole of the machine and connect it also with the head breeze electrode arranged about a foot above the vertex. Regulate the current strength according to the comfort of the patient, which will depend upon the thickness of the hair rather than the degree of tenderness.

Continue the application until complete relief is afforded, whether this requires ten or more minutes.

In ordinary cases, and especially when associated with cerebral neurasthenia or temporary congestion of the local circulation, this treatment is speedily curative. It may be repeated as often as the needs of the patient require. Probably no other form of treatment is so satisfactory. To every such case the sedative breeze is a boon.

Chronic Urticaria.—The vast majority of cases of urticaria recover in a few hours or a few days. In chronic cases it is well, says Jackson, to put the patient on a strictly milk diet for a few days and then add other articles with care.

If the gouty or rheumatic diathesis is at the foundation of the trouble it must be combated. If the outbreak shows marked periodicity sulphate of quinine may do good. Salicylate of soda sometimes does good service even when there is no evident rheumatic tendency. In fact, we must endeavor in every way to get our patient into a normal state of health.

The most difficult of cases are those in which a neurosis alone seems to be the cause. Then belladonna, atropine, arsenic, the bromides, antipyrin, phenacetin, galvanism, pilocarpine, wine of antimony, colchicum, and ergot are recommended. In very obstinate cases the patient should be sent away from home and relieved from all business cares.

Amidst the multiplicity of the above recommendations two

[illegible]

[illegible]

[illegible]

tricity in these conditions the reader should carefully study the well-known physiological actions of the different forms of administering static currents.

It will be seen that none of the electrolytic action of negative and positive galvanic currents is obtained with static applications. Static electricity does not attack pathological tissues, destroy new growths, remove superfluous hairs, set up an active osmosis, coagulate and dry up the blood supply of a vascular nævus, or soften, liquefy, and absorb an indurated mass or fibroid tumor.

On the contrary, the local action of static electricity is for the most part limited to the relief of symptoms, while its general action is directed to the treatment of the state of the patient. Nevertheless, it possesses exceedingly great value in dermatology, and the more it is employed the more it commands appreciation.

CHAPTER XXX.

CHRONIC OR SUBACUTE INFLAMMATORY CONDITIONS WITHIN THE THORAX.

Effects of static treatment in relieving symptoms and promoting nutrition. Not an expectorant or germicide, but an active nutritional tonic. Methods of treating local and general conditions of patients. Important actions of various applications. A clinical case of phthisis. A clinical case of acute pleurisy and bronchitis. Chronic bronchitis. Chronic tuberculous bronchitis and extreme anæmia. Three clinical cases of chronic bronchitis with histories and results of treatment.

In all the various degrees and stages of bronchial and pulmonary affections one thing is usually certain—the patient is below par and needs reinforcement of tissue resistance.

Relief is also often desired from distressing symptoms which drugs either relieve slowly or palliate only with depressing or injurious effects upon digestion, the heart, or general health. I particularly refer to the common use of opiates in cough mixtures and for the relief of chest pains.

Static electricity will relieve some of these symptoms with a tonic effect upon nutrition. It will relieve the pains, the oppression in breathing, the sense of constriction behind the sternum, the inability to take a deep breath, the general debility, headaches, etc., and do something for the cough.

It will promote sleep, appetite, digestion, and general nutrition. It will exert some beneficial influence upon the catarrhal secretions, but it will not specifically act as an expectorant or destroy the tubercle bacillus.

It will aid appropriate medication in extremely useful ways, and many chronic invalids who are sent to distant climates would save money and thrive better at home with the family physician and the static machine.

Commence the course of tonic static treatment with simple positive electrification for ten or fifteen minutes, after which attend to special symptoms.

Stop the machine and change to negative electrification. If there is headache remove it with the positive head breeze. If there is backache in either the upper or lower spine remove it with a spray, or a spray mingled with mild sparks; or if it happens to be of a very chronic and obstinate character, which is occasionally the case, attack it with counter-irritant and more vigorous methods.

If there is soreness in the muscles of the chest, if the muscles are fatigued by coughing, if there are local pains of any character, if there is a sense of constriction, oppression, and the patient is unable to take a deep breath, have the patient sit erect with chin well up and electrified negatively while a positive spray from the brass point electrode is slowly swept with gentle motion across the whole area of distress.

After it comforts the soreness, have the patient inhale as deeply as possible while a single spark at a time is thrown from the point of the electrode in conjunction with the spray upon the places where pain is felt—upon the sternum and supra-mammary region of each side.

The sense of relief from every symptom afforded within three or five minutes cannot be duplicated by all the other resources of the materia medica. In cases which I have thus treated, the soreness and pain have instantly disappeared, the constriction has vanished, the muscles have been refreshed, and respiration has become full and comfortable.

If the extremities are cold, mild sparks to the cervical and lumbar spine and to the arms, thighs, and soles of feet will warm up the entire circulation.

If the heart action is weak and distressed, the sleep poor, digestion weak, appetite fickle, nerves irritable, and strength at a low ebb, the whole general and local treatment throughout the entire *séance* of about fifteen minutes will be steadily at

work improving the systemic state, increasing muscular strength, lessening the worst symptoms and banishing others totally—in short, accomplishing for the patient at home even in advanced states of the graver lesions and with moderate expense about the best results that could be hoped for by costly travel in search of a curative climate. Potential alternation is a good tonic method also.

If the ailment is an exceedingly minor form of cold in the chest without actually setting up any inflammatory exudation, the soreness and inability to take a deep breath have been removed time and again by the spray and mild spark application at the first visit of the patient to my office, and the relief has been permanent without any other treatment whatever.

If the patient has a history of a former attack of pneumonia, and examination reveals a diminution or total lack of expansion on one side, a very great amount of benefit will be produced, and expansion will be either partly or wholly restored by contracting the muscles with a slowly interrupted Leyden-jar current in exactly the same manner as a faradic current would be applied.

In all the previous applications the patient sits upon the static platform without any exposure of the person, and the treatment is therefore conveniently and quickly applied to all classes of cases.

To attempt to restore activity to the rigid or inert muscles, the clothing must be removed above the waist, and I am in the habit of placing the patient face downward on an operating-chair, with a sponge-covered electrode about the size of the palm of the hand under the solar plexus and connected with the negative pole.

Another ordinary sponge-covered electrode is then moistened, lubricated with soap, and promenaded up and down the spine and over the muscles of the affected side with a very rapidly interrupted high-potential current of just enough strength to produce a decided but comfortable thrill and some muscular

contraction when the electrode passes over motor points. This application increases the blood supply, warms and relaxes the muscles, and prepares them for more active exercise.

Very slow interruptions of about seventy periods per minute are substituted in about five minutes for the previous application, and each set of muscles is subjected to a dozen or more vigorous contractions, after which the back is dried and dusted with toilet powder and the sitting is at an end. This application may be repeated every second day until improvement is fully developed.

Of the action of static electricity in phthisis, Caldwell says:

> I have marked in a number of cases its tonic constitutional effects, and have found it possible to relieve many of the severer symptoms attendant upon advanced cases. The hectic fever, the night sweats, the weak heart action, and the cough will be relieved and the temperature lessened—all tending for the time being to make the sufferer more comfortable, and possibly prolonging life a little.

These are the common observations of experience in the treatment of incurable cases. In earlier stages of the disease it is obvious that the nutritional effects of static electricity are vastly more important than when all hope is passed and nothing can be expected except a little increase of comfort.

For the relief of irritative coughs in these ordinary cases when some simple anti-congestive and sedative action through the larynx will afford relief I sometimes include a few mild sparks to each side of the throat during the treatment, or apply, which is much better, a very rapidly interrupted small Leyden-jar current with a moistened sponge electrode directly upon each side of the larynx, with the dose regulated so as to produce as much tension as will still permit the patient to swallow.

Dr. W. C. Allen, Cranford, N. J., reports the following cases:

Phthisis.—Mrs. T——, the mother of three children, became much run down and developed a cough, and an afternoon rise of temperature to 100° F., night sweats, hectic flush in the afternoon, and marked hoarseness and soreness of the

larynx, and was beginning to lose weight; and there were physical signs of consolidation of the apex of the left lung; I gave her positive static insulation, and connected the negative pole with the wooden ball electrode, giving the current over the larynx and chest, both front and back; within three days the fever had stopped and by the end of the first week the night sweats were almost gone; she steadily improved in her general condition, gained in flesh, and the cough gradually diminished, and by the end of three months she was practically well, there being no cough, night sweats, fever, and only a very little of the hoarseness, and there has been no return of the trouble, and her last treatment was given over ten months ago.

Acute Pleurisy and Bronchitis.—Mrs. —— had an acute attack of simple bronchitis complicated with pleurisy at the base of the right side. She was treated as usual, at home and in bed, with medical remedies; but when able to get up she had an intense diffused pain over a large area of the side, a persisting cough, and it was a physical impossibility for her to take a big breath. After some days without change in this condition she came to the author.

She was placed on the static platform and connected with the positive pole; the negative pole was grounded with the brass point electrode. Sweeping the point over the affected region at a distance of about four inches I administered a hot stimulating spray for about three minutes. This disposed of the pain in the side.

The entire spine was then given a couple of moments' spray, and a few dashes of spray and needle sparks were thrown upon the upper chest and on each side of the throat. She stepped from the platform in a perfectly comfortable state, could draw a full breath with normal feeling, and felt greatly refreshed. She had stopped her medical remedies three days before as they "were doing no further good." She took no other medicine afterward. Her nagging cough underwent only a gradual relief and did not entirely disappear for a week, but the other symptoms vanished beneath the negative spray like the mists of morning before the sun, and never came back. She had only the one treatment and has since remained in her usual state of health.

Chronic Bronchitis.—Mrs. ——. This was a uterine case complicated with malaria and chronic bronchitis. I will not detail her history, and will refer here only to the portion of her treatment by static. She was very anæmic, emaciated, had

constant headache, backache, cough, and complained of her feet "swelling at different times." She had become greatly alarmed over the fear that she had consumption, and when first coming to me for treatment was dosing herself with patent medicines for the cure of this disease.

She had a number of reflex symptoms from her uterine condition, but an examination of the chest revealed no evidence of anything but the ordinary form of bronchitis. She received uterine treatment, chiefly by the bipolar method; had a simple prescription for the bronchitis, and between January 22d and March 5th received static administrations three times a week.

Her headaches and backache, reflex symptoms, and distress on breathing were absolutely removed at each sitting, and returned the next day with gradually diminishing severity.

In the course of two weeks she was free from headaches, sleeping much better and steadily improving. At the time of her last visit she was "well enough to get along" from her standpoint, although I should have advised another month of treatment.

In all these cases it is usually possible to do away with the difficulty in breathing and restore the capacity for deep inhalation in a couple of minutes by a process as simple as the turn of a hand. It is preposterous to claim that there is any resource in drug medicine which will produce these nerve and muscle effects which static electricity accomplishes with precision. They may seem "magical" to the patient, but they are nothing more than the ordinary physiological action of an interrupted current of very high potential and small amperage.

No physician who would investigate these actions and witness the effect of a single treatment upon, for instance, a severe case of muscular rheumatism could maintain his attitude of scepticism in regard to static electricity. Physicians who have never witnessed its action can hardly assert that they are competent judges.

In regard to the idea, which is often associated with complete ignorance about electricity, that the forms of applying it are "constantly changing," it might do to ask those who hold this view to point out any difference in either principle or

technique between the administration and effects of a static breeze one hundred years ago and to-day. There is no difference, and the best methods of the present time will apparently continue to be the best methods of the twentieth century.

Chronic Tuberculous Bronchitis and Extreme Anæmia.—Mrs. ——, aged 25, married, has had cough for two years. Chest examined; diagnosis second stage of phthisis. In this case as in others general nutritional applications of positive electrification with a spinal breeze were employed to build up her strength.

A spray with a few mild sparks across the upper region of the chest immediately increased her power of deep respiration and removed the chest pains. She had had only occasional night sweats, and these ceased.

All symptoms except the cough were entirely relieved at each treatment, and returned the next day with lessened severity. This woman was treated two and one-half months, three times a week, with some irregularity. When she got a little better she would dance half the night, or go on a shopping expedition, or do a hard day's work and cool off in a draught. Her relapses kept pace with her imprudences, and while she maintained an improvement in all symptoms but the cough, and had increased in general strength in a very satisfactory manner, she concluded that further treatment was not worth the trouble and expense.

This case is cited to illustrate an every-day experience in practice. Shiftless patients with diseases which are wellnigh incurable begin a short and desultory course of treatment with no better results than they deserve, and forever after say the remedy did them no good. The experience is common to all branches of medical practice.

The following cases are reported by Dr. J. A. Stratton, Newman, Cal.:

Chronic Bronchitis.—My work with a static machine extends over a period of about twelve months, and the results I have seen from its use have frequently gone beyond my most sanguine expectations. We generally read of its application in such diseases as neuralgias, rheumatics, neurasthenia, insomnia, etc., and I can say in such cases I am rarely disappointed in the

results that I get from its use, and I might say, in a large proportion of the aches and pains that the human flesh is heir to, the results that may be had from the proper use of static electricity are often little less than phenomenal. I firmly believe that its field of application will be greatly broadened as we learn more of its properties and see its effects in pathological conditions. I wish to call attention to a line of work that I have followed for a few months, just passed, in the limited number of cases that I have had, and if they get the same result that I have experienced, I believe they will be more than thankful for having their attention called to the matter. I refer to the use of static electricity in chronic bronchitis, and I do not know how to present this subject any better than to copy from my case book the symptoms, treatment, and result of treatment in some of my cases.

Case I.—Miss G——, aged 36, came to me January 15th, 1896, with the following history: Has had a cough for about five years gradually getting worse, and for the past two years her general health has been failing until at the present time is just able to walk around the room. Never sleeps but a few minutes at a time, and then only in an upright position, on account of great dyspnœa, which is greatly aggravated by exertion of any kind. At the present time coughs on an average thirty to forty times an hour, never goes as long as five minutes at a time without coughing. Expectoration is muco-purulent and very profuse and tenacious; no appetite; bowels constipated; menses regular but a scant flow. A constant irritation in the throat and soreness; voice very husky. A sense of constriction across the chest, and pain and soreness over the lungs, mostly in the back. Has been afflicted with a partial paralysis of the right side for years, which lately has become much worse, but she thinks it is on account of a general weakness. Has had medical treatment from many physicians both at home and from neighboring cities, but has never noticed any marked benefit from any treatment she has ever received but has continued to grow worse all the time. Some of her physicians told her she had bronchitis; others that she had consumption. The last one told her sister that medicine would do her no good and that she had but a short time to live. Examination shows abundant subcrepitant râles over both lungs, no cavities detected nor well-marked dulness, a dropsical condition of the abdomen and legs; she cannot raise the right hand to the head, or raise the right foot as well as the left.

Treatment: Static induced through the upper portion of the

chest, placing the electrodes just below the clavicle on each side near the axilla, passing the current ten minutes to the point of tolerance short of being painful, following with sparks up and down the spine, back, and legs, also over the abdomen, following with the spray over the head twenty minutes. This treatment was continued every other day for four weeks, with a marked improvement of all the symptoms she complained of when the treatment was commenced. In ten days after commencing treatment she expressed herself as feeling better, that she could sleep nearly all night, bowels were regular, and soreness in chest nearly all gone. After four weeks I gave her treatment every third day for about six weeks, when she said she was well, but I gave her an occasional treatment for one month longer.

Patient has not had any treatment for more than six months and says she is perfectly well, has been continually engaged in doing general housework, cooking, etc., for a large family for nearly eight months, and has had no relapse since the improvement commenced, which continued steadily almost from the first, is able to use her right arm and leg as well as she ever did.

Incidentally I wish to remark that I have never used anything in chronic constipation that relieves as quickly and effectively as the sparks over the abdomen. Most of my cases are relieved after three or four treatments, but I generally give about a dozen to clinch the cure and I have never had a patient return and say the cure was not permanent. I presume there are cases it will not cure, but it has never been my lot to have such a one.

Case II.—Mrs. B——, aged 43, July 23d, 1896: Patient has had a cough for fifteen years and came to California six years ago from the East for her health. Twelve years ago had pneumonia and has been in very poor health ever since, getting worse all the time. She has about every four or five weeks what she calls a relapse, when she is confined to her bed for several days and all her symptoms are greatly aggravated. These bad spells are constantly getting worse, has paroxysms of coughing several times a day, generally worse in the morning.

Expectoration is frothy and mixed with muco-purulent sputa; complains much of dyspnœa which is greatly aggravated by any exertions, marked distress in the chest which she describes as a sore pain; appetite poor, very much emaciated, and very weak.

Examination shows subcrepitant râles over all the chest.

Diagnosis: Bronchorrhœa.

Treatment: Same as in Case I. except omitting sparks over the abdomen as bowels were regular. Patient noticed improvement in her condition in a few days after commencing treatment. Is still under treatment and is gradually improving all the time. Has had three relapses since she commenced treatment, but they have been the lightest she has ever had; she was not compelled to go to bed, and recovered from them in a much shorter time than usual. Does her housework and assists in the washing and ironing, something she has not done for more than three years. Appetite is good and digestion fine; she is gaining flesh all the time. Says she is better than she has been for many years.

CASE III.—Mrs. O——, aged 29. Patient has been troubled with a cough for six years, which is always worse at night, much soreness in chest and throat. The latter troubles her constantly and she complains more of it than of anything else. Cough keeps her awake the greater portion of the night. Expectorates very freely a muco-purulent sputum, often streaked with blood; appetite very poor and bowels constipated all the time; is not able to do any housework. Also suffers with uterine trouble. Patient was treated by the writer with medicine three years ago and greatly benefited, but now she says she is worse than she was before. Had a sister die from lung trouble, thinks it was consumption.

Treatment same as in Case I.

To-day, three months after commencing treatment, which has been very irregular, as the patient lives about fifteen miles in the country, she says her lung trouble is all right, she rarely ever coughs, and her throat has not troubled her for more than a month, while before commencing treatment it was sore all the time; bowels regular and have been so all the time since commencing treatment. I see by referring to my case book that I have given this patient nine treatments; she is still under treatment for the uterine trouble by the use of the galvanic current, and is steadily improving although very irregular in her attendance. She passed through her last menstrual period without any pain, something she has not done for a long time before.

CASE IV. is that of the writer, who has had bronchitis for more than twenty years, and a few treatments given at irregular intervals have dispelled the cough entirely; he feels greatly relieved by not having his sleep disturbed by almost constant coughing. He never found any medication that gave more than

temporary relief. Has not coughed for months until recently, when he had an attack of acute bronchitis which is improving all the time and at present gives but little annoyance.

In conclusion I wish to call the attention of the profession to the relief they can give their patients with pharyngitis, even when complicated with rhinitis, by the use of the static induced current. I have many patients who are troubled with rhinitis complicated with pharyngitis, and I invariably find that a few applications of the static induced, passing the current through the throat from side to side, relieves all those distressing symptoms promptly.

CHAPTER XXXI.

MORBID MENTAL STATES.

The physiological action of static electricity indicates its value. Effects of static electricity in regulating the functions of the mind and body. Clinical cases with results of treatment. In milder forms of mental depression secondary to functional derangements static electricity surpasses all other remedies. Report of cases treated with static methods.

Some degree of physical ill-health causes or complicates the departure of the mind from normal action. In either case a two-edged sword is at work cutting both ways, and the mental and physical states grow worse together.

The majority of recent cases of impaired functionation of the mind have either sleeplessness or active brain excitement, or mental torpor, or morbid motor activity, or the reverse, as part of their symptoms at some time.

Almost every state of physical disease affects the mind secondarily; and as an ounce of prevention is worth a pound of cure, it becomes forcibly impressed upon the mind of every one who studies insanity in its most common forms that some time before the door of an asylum opens to receive the patient there should be an earlier effort made to nourish the body, to restore its nervous energy, to regulate its functions, to direct thoughts into healthy channels, to exercise muscles and subordinate centres, so as to provide physiological and safe outlets for hyperexcitability, increase self-control, sleep, composure, and normal digestion, and occupy the mind in a happier way.

The physical changes which accompany certain forms of insanity are very marked. In melancholia the skin often becomes rough, dry, and hard. The hair changes and becomes coarse and wiry in many cases. The tongue is seen to be milky and

tremulous, the hands disclose a tremor and sluggish capillary circulation.

If these external appearances are associated with similar perversions of nutrition in the brain substance the mental state is easily accounted for.

It is not, however, of mental alienation which has conducted its victim to an asylum that I wish chiefly to speak, but of the treatment of states of the mind which come to the office of the general practitioner and which are yet far from the portals of insanity, or if bound to that ultimate destination have made so little progress that the danger is not suspected by either themselves or friends.

When a person is unable to think clearly or continuously upon business or domestic matters; to fix the attention; to control the memory; to maintain cheeriness of spirits; finds that the faculties are either dull and sluggish on the one hand, or restless and overactive on the other, this state of things is almost certain to be removed during the application of some suitable form of static electricity. In exerting its influence in regulating the functions of mind and body into normal methods of action, its beneficial effects are accomplished without any of the drawbacks attendant upon the immoderate use of hypnotics, sedatives, stimulants, and motor depressants.

When the disturbing mental symptoms are dependent upon some physical disease of a curable nature, and more especially if they are the result of worry, overwork, excitement, grief, shock or alarm, or long-continued loss of sleep, the beneficial action of static electricity is pronounced.

There is nothing equal to it to clear up the mind, brush away the cobwebs, or soothe it, re-invigorate it, and re-establish its normal workings when these are impaired by purely functional derangements.

If in states of great neurasthenia the memory is so weakened as to be almost lost, and the mind is so debilitated that even the mere thought of performing a simple act has set the patient

in a tremor and caused her to fear that she was losing her reason, I have seen the patient in four weeks' treatment with positive electrification, nourishing food, and iron, leave my house with a sturdiness of mental and physical vigor she had been a stranger to for years.

To give minute consideration to every variety of morbid mental state and discuss it in detail would require a book by itself; but to those who are especially interested in sanatorium or asylum practice in the treatment of the more advanced cases of this kind it is sufficient to say that a study of the physiological action of static electricity will acquaint them with a remedy of great value, and if they will but learn how to employ it, it will lighten their cares, reduce their difficulties of medical prescribing, win the approval and appreciation of their patients, and produce results which in no case will be injurious, in a few cases will be brilliant, and in almost every case will benefit the patient in some way.

The treatment of these cases cannot always be carried out upon indicated lines. Whims must sometimes be humored, and tact, discretion, and personal management will be necessary to induce some of the patients to accept the form of treatment which will do them the most good; but all patients become instinctively aware of whether the operator is skilled or bungling, and they will usually act accordingly. The more competent the operator in the management of technique the more certain it is that he will achieve the best results with the least difficulty.

The following cases and remarks were reported by Dr. W. F. Robinson*:

CASE I.—Julia O——, aged 19, servant. Family history good except her father, who was a drinking man. She has two sisters who are apparently all right. Has a mother and an uncle, both in good health. About two years ago her father suddenly disappeared, and some months afterward his body was recovered from the river, he having in all probability committed

* Journal of Electro-Therapeutics, July, 1894.

suicide. The disappearance of her father was a great shock to the girl, and since that event her whole character changed. From being bright and cheerful she became sad and despondent, and instead of getting over it as time went on she seemed to grow worse.

When she was brought to me a little less than two years after her father's death, her condition was as follows: She is a little below the medium height and well nourished. She feels very sad and despondent, weeps a great deal; has no hope of ever being any better, and had to be almost dragged to my office by main force by her friends.

Fortunately they were very much alarmed at her condition, and fearing that she was really going crazy, they insisted upon her seeking medical advice. She has a great deal of headache, and feels tired and unequal to her work. She worries constantly about her mother, who is notwithstanding in very good health. She also torments herself with the idea that her own work is not well done, which is very far from the case, since she is a very good worker. She often speaks of the river, saying that she longs to plunge into it and rejoin her poor dead father. She sleeps wretchedly, and frequently has attacks of weeping at night. Finally, all the above-mentioned symptoms had been growing steadily worse for some time previous to the date of her consulting me.

This might appear to be a simple case of hysteria or nervousness, and yet to the experienced observer there were very evident signs of approaching insanity.

The peculiar ideas which she entertained regarding her mother's illness and her own work, although hardly to be called delusions as yet, would not be long in developing into them. If this case had been allowed to go on it would in all probability have developed into outspoken melancholia with suicidal ideas. Indeed, the act of suicide might have been suddenly accomplished before her friends realized what her actual condition was.

Treatment: Small doses of the compound syrup of the hypophosphites were ordered, and she received the simple static charge for ten minutes three times a week. All her symptoms began to improve from the very first. First of all she began to sleep better—always a good augury for the results of the treatment. Then the crying spells were less frequent and shorter in duration. After two weeks of treatment she would occasionally laugh again. She received altogether seventeen treatments extending over a period of six weeks, at the end of which

time she was discharged as cured. The morbid ideas, along with the attacks of weeping, had disappeared. The appetite and sleep returned, and she felt strong and ready to work.

While working she would laugh and sing in her old way, and her friends declared that she seemed to be just as she was before her father died.

This case is not by any means an isolated one, but, on the contrary, it represents a class of cases frequently to be met with. In the transition age of puberty or adolescence, when the mind is filled with new thoughts and emotions, it is especially sensitive to disturbing influences. The disturbing influence was supplied in this case by the sudden disappearance of her father. This acting on the girl's sensitive and high-strung nervous organization was sufficient to throw it off its balance.

The following case should not perhaps be cited here, since when brought to the writer's notice it was no longer incipient but outspoken insanity, of the form known as melancholia. Though the disease was well defined, it was still in an early stage, and what is still more important, it was possible to treat it at home with careful watching. Cases as serious as this one are kept at home with a good deal of risk, owing to the liability of suicide.

CASE II.—Miss M——, aged 38. Family history very bad. Her father and mother were own cousins as well as her paternal grandfather and grandmother. Her father was insane to a mild degree, having well-marked delusions of persecution as well as other symptoms. His uncle had had softening of the brain when an old man. The patient's mother had a sister and a niece who were insane. The patient was of a sensitive disposition, but had enjoyed fair general health most of her life. She had suffered at one time from lateral curvature of the spine, from which she entirely recovered under appropriate treatment.

More than a year before the patient was brought to me her father was taken with the *grippe*, and as he recovered from this malady he developed well-marked symptoms of insanity. Although his bodily strength had returned he refused absolutely to go out. He would walk around the house, looking first out of one window and then out of another, and declaring the people in the street were gathering to attack him. At times he would become profane and violent.

It can readily be imagined what effect this would have upon the mind of the daughter. She soon began to be nervous and sleepless, and would not go out herself. She got so that she could not keep still even to eat her meals, but would stand or

kneel at table. When brought to me her condition was as follows:

Patient was stout and healthy-looking. Appetite and digestion fair. Her mental condition was one of most demonstrative grief. Could not keep still, but walked very rapidly up and down all the time, wringing her hands or pulling down her hair. She could hardly contain herself; groaned and uttered such exclamations as: "I cannot endure it," "I will not have it so," "Why did I allow myself to get into such a condition; it is too late and my life is ruined." She was unable to fix her mind upon anything—either to sew, read, or play games. Her sleep was very poor.

Treatment: A good generous diet was ordered for her, and she was made to go out every day for a walk. The static charge was given daily—for five minutes at first, and then for ten minutes. The improvement soon began to manifest itself in better rest. After walking in the morning she was more quiet and like herself. Gradually she became less nervous and did not talk so much about herself.

She received twenty-eight static charges in as many days, and then it seemed very desirable for several reasons that she should be taken into the country, since quiet and fresh air are both very valuable adjuncts in the treatment of this disease. She was therefore taken to the house of a relative who lived on a farm, where she was kept almost constantly in the open air. The result was that the improvement continued without interruption, and three months later she was brought into my office in a condition of perfect health both bodily and mentally. This made the time four months in all, from the time I first saw her to the date of recovery.

This case is also cited for the purpose of showing what can be done outside of an asylum. In view of the terrible family history which this patient presented and the aggravating character of all the circumstances, the writer could not but feel a certain satisfaction at the result obtained.

The last case cited will be that of a patient suffering from climacteric insanity, a common form of disease seen in our country to-day.

This form does not necessarily come on just at the menopause, but may occur shortly before the cessation of the menses or as late as five or six years after this event.

These cases generally yield to the electric treatment, but on the other hand they are quite apt to suffer relapses.

When a case of this kind has been sent home cured, it is

always desirable to warn the family of this fact in order that they take special precautions to guard against a return of the malady.

CASE III.—Mrs. T——, aged 50, has a husband and one son, both of them devoted to her. Always enjoyed fair health up to this attack. The courses ceased about four years ago. About a month before the writer saw her, she began to worry about her clothes. She could get nothing to suit her. When a new dress came home it pleased her so little that it went back to be altered, but when it returned it would still be unsatisfactory, and perhaps go back a second time. Her character also underwent a change, and she became abnormally depressed and nervous. She seemed to lose all interest in everything.

When brought to the writer for advice she presented the following condition: A sad-faced lady, well filled out without being fat. Very listless and passive in her movements and general demeanor. Appetite and bowels fair. Sleep very poor. Complains of constant headache, also pains in various parts of the body. She was ordered a preparation of phosphorus, and the static charge was given daily for five minutes. The electric treatment is generally very efficacious in producing sleep, but this patient was so insistent in demanding some hypnotic that a small powder (five grains) of sulfonal was given her every night, more for its moral effect than anything else.

Under these conditions she slept very well with the exception of one or two nights.

This patient was most obstinate in her determination to look on the dark side of the matter, and never tired of repeating that she was never going to get well and be restored to her family, and whatever encouragement we tried to give her she said we did as a matter of course, and that we knew perfectly well that her case was hopeless.

In spite of this determined mental attitude of the patient, her improvement could almost be seen from day to day. She was made to walk or ride out every day, although she frequently demurred at this. When the weather was fine she was sent with an attendant or friend to take a long ride on electric cars or the boats.

During the first week of the treatment she would have almost every day peculiar attacks, in which she would "go all to pieces" as she expressed it. She would lose all control of herself and walk up and down the room exclaiming, "I cannot stand it another minute," "I am going crazy," etc. The actual attacks

grew less and less frequent, and finally disappeared altogether. At first she declared she could not touch sewing of any kind, although naturally very skilful with her needle. After the first week, however, she began again little by little, and by the end of the second week she would spend an hour or two every day in doing fancy work.

She was under treatment exactly one month, at the end of which time she was able to return to her family.

The histories of these three cases will serve to show the method of using electricity and the results obtained.

My experience in the use of this agent leads me to conclude:

First, that it has a powerful action on mental affections in their early stages.

Second, that many cases of insanity, or, to speak more correctly, of mental disturbance leading to insanity, may, if recognized in time, be treated and cured by this agent, and the outbreak of the fully developed disease thereby avoided.

Dr. W. C. Allen, of Cranford, N. J., reports the following: From a personal use of the static electricity, as well as the other forms, for about two years continuously, I must unhesitatingly say that no other form of electrical treatment will work such marked and lasting benefit in all forms of depression of the general and especially of the nervous system as this one form; and this is the case whether the depression is of the bodily or mental spheres; a single treatment will quiet an overexcited nervous system, and tone up an exhausted body in a manner which cannot be understood except by actual observation. I have personally cured, not relieved for a time, but cured nervous sick-headaches, which had been making the patient miserable for days, by a twenty-minute treatment, and have repeatedly had the patient go to sleep while taking treatment, and not awake until the machine was stopped, and when they did awake they were entirely free from headache, feeling, as they expressed it, much rested, and here I desire to state that I have found the most soothing effect is gained by the static breeze.

In the various forms of mental depression, such as mild mel-

ancholia, I have found it very beneficial, and I know of nothing, either in medicine or massage, or any of the other forms of electricity, which will compare to the static in the treatment of this trouble; and the benefit is not temporary, as some have stated. The patient seems to have more resisting power, and, as one patient said, "things do not worry me as they did formerly because I don't let them."

CASE I.—Mrs. A——, married, and the mother of several children, two living, became very much depressed because of the state of her husband's affairs, and finally she became so bad that it was necessary to watch her constantly to prevent her from doing herself harm, which she had several times tried. She knew that she was dying, and that she had better die as soon as possible so as to make the burden of the expense to the family less; medicine did no good, and she had doctors from both schools. Finally, when I saw her she was profoundly depressed, waiting to die, and when the treatment was mentioned she did not want to take it as it would add further expense to the family, etc. The first few times she came she was brought in a carriage, as she seemed too weak to walk, and the treatment was connection of the platform with the negative pole and the positive attached to the spray electrode, and the current directed over the temples, vertex, and the nape of the neck; her condition steadily improved; she took more interest in events about her, talked less about dying, and after two months' treatment—at first every day, and later every other day—she was practically all right, attending to her regular duties, no signs of the former depression, and, although the business affairs are no better now than they were when she was taken sick, she says, as I have already quoted, she does not let them affect her, and looks on the bright side of everything. Her entire treatment was electrical, as all medicine was stopped when she began taking electricity.

Report of cases treated by William M. Knowlton, M.D., Assistant Physician Channing Hospital, Brookline, Mass.*

While static electricity has not supplanted faradism or galvanism in Channing Hospital it has proved a very valuable

* From recent personal letters from Dr. Knowlton.

agent in the treatment of certain forms of mental diseases depending on functional, nutritional, or circulatory disturbances, rather than organic changes.

The following is an abstract from the hospital records of a few cases treated by this method:

CASE I.—Simple melancholia. F. G——, a female, single, aged 55. Admitted May 16th, 1895. The illness began four weeks previously. She could not apply herself to any occupation, she was depressed and careless in her personal habits. She grew worse, and three months later it is recorded that "she often refuses food, she sleeps poorly, does nothing. She is in bed or on the lounge all the time." She is much distressed on account of her wickedness. The depression, with much mental and physical agitation, continued through the autumn and winter. April 3d, 1896, it is stated that her condition is much the same. Began treatment with static electricity—applying the spray or breeze to the head, and sparks to the spine ten minutes, this treatment to be repeated every second day.

May 21st: In the morning she is depressed and hopeless, but later in the day is quiet and will talk some on general subjects. She is sleeping and eating a little better. Treatment continued.

September 1st: Improvement began to be more noticeable last month and is now quite marked. She walks, drives, reads a little, and does some needlework.

October 1st: She is quite well, her weight has increased fifteen pounds. During the first twelve months she required a hypnotic often, a laxative occasionally, and at times a tonic to aid digestion. Since then static electricity has been the only therapeutic measure employed.

CASE II. Hypochondriacal melancholia. M. C——, female, widow, aged 62. Admitted September 18th, 1895. Since an attack of *la grippe* three years ago she has had frequent attacks of distress in the umbilical region which she terms faintness rather than pain.

This faintness is usually followed by several dejections, after which a state of nervous irritability comes on which lasts often for hours. Coincident with these attacks urticarial blotches appear which for a long time she thought were due to insects. The skin is dry and rough.

October 15th: She is at times quite melancholy, feeling that she will never be any better. Attacks of distress in the abdo-

men with the accompanying mental symptoms occur frequently.

December 1st: She is often wakeful and noisy after 3 A.M., and is always depressed in the morning, but quiet in the afternoon. Static electricity is prescribed in the form of spray applied to the head, and sparks over the stomach, abdomen, and spine, ten or twelve minutes every other day.

January 1st, 1896: Although she has some periods of depression attended with the usual abdominal disturbance, on the whole she is much more comfortable and at times hopeful. The distress in the bowels is always relieved by the application of sparks from the static machine, and she feels less nervous after treatment, after having a nap on returning to her room.

February 1st: She has improved very much since the last record. She is stronger physically, and is quite cheerful most of the time. The patient states that about a month after the treatment by electricity was begun she noticed that the skin, which had been dry and uncomfortable, was smoother and softer.

March 1st: She is entirely free from depression. She takes an ordinary diet with no unpleasant consequences.

CASE III.—Delusional melancholia. E. J——, female, married, aged 49. Admitted December 20th, 1895. This patient has suffered from indigestion for years. The past two years she has been growing nervous and hypochondriacal. Insomnia has been marked. She takes a very small amount of food, and has lost flesh, weighing one hundred and twenty-five pounds which is almost fifty pounds less than usual. The past two weeks she has been confined to the bed. On admission she is pale, thin, agitated, and depressed. She says she is going to die—that there is no help for her. She talks constantly about her severe suffering and has delusions in regard to her body and the food. She continued in much the same condition through the winter.

On March 5th, 1896, it is recorded that she sits up a few hours every day. She takes nearly all her food in liquid form. She says she will never be able to eat again; that her sufferings are "damnable" and she wishes she could die. Began treatment by static electricity, applying sparks ten minutes to the spine and over the stomach, liver, and abdomen, to be repeated three times a week.

April 15th: She takes more solid food. Her weight has increased twenty pounds, but she says she will have to sit and starve. She complains of various painful and disagreeable sensations from her head to her feet. Treatment continued.

July 1st: She has improved since last record. Although at times she is irritable and complaining, she is often cheerful and animated, and manifests an interest in her surroundings.

August 15th: She is much better in every way. She sleeps quite well. In this case and the preceding one hypnotics, pepsin, nux vomica, malt, and partially digested foods were employed for the first few months afterward. Electricity was the only therapeutic agent employed.

Case IV.—S. G——, female, married, aged 45. Admitted March 12th, 1896. She went to a sanatorium in June, 1895, on account of an attack of mental depression not amounting to insanity. Menstruation ceased two years previous. A few weeks before being transferred to this hospital she began to grow excited. The excitement and confusion of mind were increasing when admitted, and subacute mania developed and continued through the summer, improvement beginning in August. By the middle of October her mind was clear, but she was left in a somewhat depressed neurasthenic condition. Some of her former troubles reappeared, such as frequent backaches and headaches, sometimes accompanied by dizziness and nausea, and various other nervous manifestations, including inability to use the eyes for any length of time, and painful joints. The urine was normal. Salicylate of soda, then salol and phenacetin were prescribed with slight relief.

October 30th: A well-known specialist examined her eyes and reported that he found "nothing wrong except that she needs stronger glasses for reading than usual at her age, readily to be explained by a certain amount of neurasthenia."

December 1st: She is discouraged at times over her slow progress. Began treatment to-day by the electro-static bath, with the spray applied to the head and sparks to the spine, arms, and legs for ten or twelve minutes, to be repeated every second day.

January 1st, 1897: The headaches and pain in the back are relieved by the electricity and recur less frequently.

Sometimes after a treatment she says she feels "lighter and more like doing something." At the present writing (January 25th), the patient continues to improve and is in a more hopeful state of mind.

In a paper entitled "Some of the Important Aspects of the Therapeutics of the Nervous System," by Dr. J. J. Putnam (*Journal of Nervous and Mental Disease*, January, 1895), he

makes a statement that seems to be especially applicable to the cases like the one just described as well as to nervous diseases. He says: "As adjuncts to direct mental treatment, it is often useful to follow out systematic and prolonged courses of treatment of other sorts, and among these static electricity is especially worthy of mention. It may be of value in other ways, but it certainly is an aid in securing mental and muscular relaxation, and making the patient more susceptible to auto-suggestions of useful kinds."

One patient, a lady aged 63 who thought she saw a great many insects wherever she went, and for a year had had a delusion that they were in or on her skin, was treated every other day with the electro-static spray for three months without relief. Another patient, a lady aged 32 who had recently recovered from an attack of acute mania, but had some head- and backache, was treated by the electro-static spray to the head and spine, but would not have it repeated because it "stimulated her brain too much."

We have not used electricity in acute form of insanity. Benedikt reports the cure of a case of mania with grandiose delusions by the use of the electro-static breeze.

In addition to the benefit derived from static electricity in mental diseases, we have obtained excellent results in neuralgias, myalgia, muscular rheumatism, and in nerve and brain fatigue. We have found it advisable in mental or neurasthenic cases to begin with a mild electro-static breeze and a short spark and gradually increase the strength of one and the length of the other.

As far as our observations go in regard to the immediate physical effects of this form of electricity, they corroborate, in the majority of instances, the statement that the temperature is slightly raised, if normal or subnormal; the pulse slowed, if fast, and there is often a feeling of warmth similar to the pleasant reaction after a bath.

In the "State Hospital's Bulletin" for July, 1896, Dr. P. M. Wise, superintendent of the St. Lawrence State Hospital for the Insane, reports six cases of insanity treated by static electricity as follows:

CASE I.—Male, aged 46, epileptic convulsions since fourteen years of age, latterly also; simple melancholia. Treatment: Static bath five minutes, and a faradic application to the crown for ten minutes daily. Had but one convulsion in six weeks. Became cheerful and hopeful. After ten weeks continues to

improve, and patient ascribes his bettered condition wholly to his electrical treatment.

CASE II.—Male, aged 38. Melancholia of four months' duration. Six months after admission he arrived at a condition of fair nutrition with mild depression, but he did not respond to the application of further remedies, and gave promise of becoming a chronic case of melancholia. Treatment with static electrification and head breeze daily was followed by immediate improvement, and recovery in about three months.

CASE III.—Male, aged 27. Melancholia, duration two years, some evidence of dementia. Two weeks after commencing treatment with static spray, ten minutes daily, improvement began, and two weeks later he appeared fairly well. The only addition to the treatment by static electricity was regulated outdoor exercise, which had previously been tried without avail.

CASE IV.—Male, aged 43. Admitted in a condition of acute mania. Two months later had become quiet, but had reached a stationary condition when daily *séances* of static electricity were followed by immediate improvement, which continued to recovery.

CASE V.—Male, aged 51. Chronic melancholia of one year's duration without improvement. Static electricity was applied in ten-minute *séances* daily from July 16th to September 15th, 1895. July 18th: During the first five minutes of application the patient's hands trembled very noticeably and then became steady.

On the 30th of July it was noted that the extremities were cold before the *séance*. August 9th: Improving, does not require to be urged to accept further treatment.

CASE VI.—Male, aged 49. Subacute mania of two years' duration. Treatment, static bath alternating with head breeze. After ten days the case-book records: "His appearance improved. Patient very rational and asserts that this course of treatment is doing him good."

Discharged at the end of five months, recovered.

Dr. Wise adds that in many cases in which little hope of recovery was held, recovery ensued after prolonged treatment by static electricity alone. In one case of neuritis the patient's delusions were confirmed by attempting to walk suddenly after a *séance*. The cases reported were treated by static electricity alone. The ordinary form of application was positive electrification and the breeze. Sparks were seldom used except when

some local effect was desired. The first manifest results of this treatment are a quickening of the pulse rate, a flushing of the surface, and a stimulation of the excretory function of the skin. An improvement in nutrition, a brightening of the mental faculties, and improvement in appetite, increase in weight, and regularity of sleep, are the earliest symptoms of improvement. Dr. Wise believes that the current has a distinct effect on the vasomotor apparatus and acts as a stimulant to the circulation and nutrition.

Although the number of cases reported is small the results obtained both by Dr. Wise and myself, and the testimony of others, prove, I think, that in static electricity we have a very valuable therapeutic agent in the treatment of mental diseases, especially in all forms of chronic psychical depression, and that a certain number of the latter class of cases whose recovery seems hopeless may by persistent treatment with some form of static electricity be restored to health, or at least to a condition of some comfort and usefulness in life.

The above exceedingly interesting report, communicated by Dr. Knowlton in a personal letter to the author, is an important addition to the subject of electro-therapeutics in the treatment of mental diseases. My own personal experience cannot go so far as the cases cited above, for the class of patients which I receive into my own residence for treatment fall short of the states which require hospital care. I have, however, very decided convictions about the value of the entire resources of electro-therapeutics in the treatment of all forms of mental alienation in which there remains any possibility of improvement or recovery. Cases dependent on progressive organic lesions do not come under this head.

In acknowledging herewith my indebtedness to Dr. Knowlton for his valuable report I may with profit also cite a case of hysteria to which he refers in his letter to the author, although it was not intended for publication:

"I have under treatment a case of hysteria of several years' standing, the past year and a half presenting many of the stigmata of hystero-epilepsy as detailed by Charcot, especially the auræ of different kinds, usually starting in the left ovarian

region and extending upward and through the præcordial space. Hysterical attacks occur from once to several times a month—latterly about once a month. She has fugitive pains and painful points on the left side of head, face, body, left ovary, left arm and leg. These hysterical pains have been relieved each time the static spray has been applied. It has so far been employed, however, only two or three times. Once during an attack the static spray and head breeze were applied with partial relief for the time. The treatment has been of too short duration to warrant conclusions, but I am encouraged to continue it."

I may suggest that the treatment of a case of this kind should preferably consist of daily applications of positive general electrification, together with such other general nutritional methods (as described elsewhere in this book) as the particular patient in question can be induced to accept with benefit.

Each sitting should be long continued—from twenty to thirty minutes—and if mild positive sparks can be comfortably applied they should be directed both to the spinal centres and to the particular sites of reflex symptoms.

The actual treatment of an explosive attack by static electricity is not a matter of much importance, although it will be gratifying to obtain whatever relief it will afford at such a time. Recovery must be looked for through the progressive improvement which can be established by regular daily treatment. The whole theory of the pathology of these affections coincides closely with the characteristic physiological action of static electricity as set forth in Chapter XII., Part I. of this book.

CHAPTER XXXII.

CHRONIC CACHEXIAS.

Cramps in the legs. Immediate relief given by static sparks. Chronic malarial cachexia. Benefit of positive electrification. Local sparks upon the spleen and liver. Syphilitic cachexia. Static electricity not a specific remedy. Its value as an agent to improve nutrition and relieve symptoms. Malaise. Chronic cachexias in general. The basis of successful treatment. Static electricity similar to a change of climate. Its influence upon negative states of the system. Frequency of treatment. Results of treatment in incurable cases. The treatment of epileptic patients with static electricity. Results of treatment. A clinical case.

Cramps in the Legs.—The static spark affords as certain and permanent relief from this affection as it does from acute myalgia. The relief begins immediately at the first sitting and after a few *séances* generally becomes established. Cramps in the calves occurring in women may depend upon pelvic conditions that require attention before the muscular spasms will be permanently relieved. Galvanic and faradic currents also affect this condition favorably, but the superiority of mild static sparks, which require no removal of clothing, is too obvious to be discussed. Rapidity of action and permanency of effects is also decidedly in favor of static sparks.

Chronic Malarial Cachexia.—In addition to indicated drugs a decided benefit to the patient is produced by static electricity. Positive electrification for fifteen minutes repeated daily or every second day is decidedly helpful in combating the electro-negative cachexia of malaria. Sparks, mingled with a stimulating spray from the brass point electrode, up and down the spine and over the spleen and liver should be applied for about five minutes before the close of the sitting.

Similar treatment is exceedingly effective in hastening the

return of strength after an acute attack of "chills and fever," and when applied at the onset of a chill will abort it; at least this has been the author's experience in a number of cases.

Syphilitic Cachexia.—Static electricity does not treat syphilis or any specific poison. Inasmuch, however, as the later stages of this disease are sometimes complicated by conditions and symptomatic derangements which call for local relief or constitutional measures of a tonic character, it is well to remember that in the Holtz machine we possess an efficient means of giving symptomatic relief and nutritional aid to the patient even though a cure of the syphilis itself depends on other remedies. Electricity will act harmoniously with these remedies and add considerably to the patient's satisfaction.

I have rarely seen—never to my present recollection—a weak, cachectic, anæmic man, suffering from head, joint, or muscle pains, nervous or circulatory disturbances, or any of the functional miseries that sprung out of Pandora's box, refuse to receive the usual benefit from static electrification because he once had syphilis. I have seen a persistent headache in a well-nourished and powerful man which was not at first suspected to be syphilitic, but which incapacitated the man from work, remain relieved for twenty-four hours after the application of each static head breeze repeated three times a week.

When any pain is promptly relieved but promptly recurs again in this manner during static treatment, it is diagnostic of some cause not previously suspected but which is not amenable to the action of the current. A closer examination of the patient should therefore always be made to discover and remove the underlying cause. In this case the patient finally admitted what he had at first denied, and upon taking a mercurial, or rather mixed treatment for a week, and omitting the static application, his headache remained as bad as ever. He accordingly returned again for the static application which he had found to afford him such welcome though temporary relief,

and this time there was a rapid improvement of his general condition and the headache soon ceased to give further trouble.

While it may be assumed that in any chronic disease upon which medication exercises a slow and gradual influence the patient will receive in time the full measure of relief from symptomatic manifestations, yet there is something eminently satisfactory to the patients in accelerating these benefits and in providing them with an immediate sense of well-being, renewed energy, muscular strength, and relief from disturbing symptoms. If the faculties are thick and dull they are wonderfully cleared and refreshed by the positive breeze on the spine and head.

Malaise.—When the condition of malaise, languor, and inability to exert the faculties in any desired work is due to temporary functional derangement, it is removable in a few moments' time more certainly and permanently by static electricity than by any other medical means. Even if quinine, or an unloading of the portal circulation, or any other procedure is also required for lasting effects in malaise of a more deep-seated character, the static application will give immense immediate relief.

Seat the patient upon the platform connected with the positive pole and ground the negative pole. Between the metal tray and the patient's feet insert the usual mat of protecting material, and administer about ten minutes of potential alternation.

The restorative effect of this method will be enhanced by a mild application of positive sparks to the general surface of the body before closing the sitting, in cases who will receive sparks agreeably.

Chronic Cachexias in General.—In these depraved states of whatever sort—whether malarial, pulmonary, specific, or any other condition susceptible of relief from harassing symptoms, and temporary if not permanent constitutional improvement,

the general and local methods of static applications are of practical value.

The basis of treatment will be general positive electrification for fifteen minutes if no local application is required in the individual case.

Other measures such as the spinal or head breeze, sparks to the spine, abdomen, liver, spleen, extremities, or special nerve trunks, should be engrafted upon the simple tonic electrification, either for the relief of local symptoms, or in almost every case for their additional effects upon nutritional activity.

Both medical and hygienic resources need all the aid they can get in the treatment of these chronic and often incurable conditions. Static electricity is the most practical and useful auxiliary remedy that I know of, and can do more to promote comfort, and re-establish as near a state of health as is possible, than many things commonly recommended. The patient is very much more certain to be benefited by three months of treatment with the static machine than by three months of travel and change of climate.

Frequency of treatment should be regulated by the effects upon the individual patient. Daily *séances* are advisable until benefit from a single treatment is fully maintained for more than twenty-four hours. Applications may then be made every second day, and finally the patient may return for treatment only when the need of it is felt.

Those who have learned not to expect to cure all the chronic ills that flesh is heir to, but are thankful to be possessed of a means which will help them improve the condition of patients who are likely never again to enjoy sound health, will obtain the greatest possible aid from a skilfully handled static machine.

Before undertaking these cases the physician should ground himself in the study of the physiology of static currents and the operation of the apparatus.

The Treatment of Epileptic Patients with Static Electricity.—In so far as the individual is in poor general health

with depraved nutrition, aggravated perhaps by the depressing effects of drugs, benefit may be reasonably expected from static administrations. The seizures may also be reduced in frequency. In cases associated with pelvic derangements, the gynecological applications of galvanic and faradic electricity will also do much to improve the condition.

Of the actual cure of epilepsy, however, I have nothing to say. In young subjects, whose attacks are recent and apparently due to some exciting cause which static electricity will ameliorate, the prognosis would be better.

One thing is certain, and that is the general toning-up of the whole nervous system which will take place during a course of static treatment. This is well worth securing in almost every case which has long been subjected to the influence of bromides.

Two years ago I attended a patient about fifty-one years of age, whose epilepsy had been "traced to the ovaries" by one of the most distinguished gynecologists of this generation. During the pioneer days of laparotomy he had removed this lady's ovaries without any subsequent effect upon the epilepsy. When she died suddenly with fatty infiltration of the heart, the autopsy which I attended disclosed the fibrous bands of a localized old inflammation of the dura, and the epileptic seizures were attributed by the pathologist to the irritation at this point.

This case shows how uncertain the removal of ovaries, the application of electricity, medical or other remedies, may be in the treatment of epileptic patients.

It may be said of static electricity in its relation to epilepsy that quite a number of physicians have had different experiences with it, and that in cases which have the least amount of structural change as a cause the prognosis is most favorable; and in all cases the general health of the patient will be benefited if this is below par. Each case, however, must be considered by itself and the patient should be treated without any promise whatever.

Dr. F. A. Kraft, Milwaukee, Wis., reports the following case:

Epilepsy.—Mrs. L. M——, a lady, 32 years of age, presenting a severe case of epilepsy, which was the result of fright dating back about four years.

The lady was in perfect health previous to her first attack. The epileptic fits were of great severity and occurred on an average of twice in three weeks. Her appetite was very poor; the bowels did not move unless a cathartic was taken. The patient looked like a shadow, and her family despaired of her life.

I recommended static electric treatments and began to give the same, one every day for thirty days, prescribing additionally compound syrup of phosphate. On the seventeenth day from beginning of the treatment she had a slight attack of an epileptic fit, lasting only a few minutes. Her appetite improved, she gained nine pounds during the first month, her appearance has changed for the better, and constant improvements are recorded. After the thirtieth static application I lessened the treatments to one every other day, and gave her twenty more.

The results were incomparable to any case of this kind I ever had to treat. The 3d of September, 1896, the lady looked like the healthiest person that ever lived, had gained two and one-half pounds during the time of her taking treatment, which after the fiftieth call I diminished to two treatments a week, and although I cannot pronounce her case a complete cure, it has plainly shown what results are obtainable from proper systematic treatment with static electricity.

P.S. November 30th, 1896: the lady, Mrs. L. M——, had to this day not a single attack of epileptic fits, feels well, and I think the case will result in a complete cure.

CHAPTER XXXIII.

TONIC EFFECTS IN VARIOUS CONDITIONS.

Convalescence from acute exhausting diseases or any low state of health. Method of employing static electricity. Its importance as a remedial agent. Nutritional remedies always indicated in these cases. Clinical observations of the effects of static electricity upon nutrition and increase of body weight. Selection of methods. The oscillating static current. Therapeutic actions. Benefits to patients treated by static electricity. Chronic effects of shock. Methods of treating patients. Chronic effects of heat prostration. Value of static electricity in restoring nerve tone. Methods of treatment. Nervous chill. Other forms of chills aborted by static sparks. Static electricity as a regulator of the temperature and circulation. "Half-frozen" patients quickly warmed during treatment upon the static platform. Curative results. Enuresis relieved by sparks to the perineum. The value of tonic general electrification in chronic interstitial nephritis and chronic catarrhal cystitis. An illustrative case.

Convalescence from Acute Exhausting Diseases or any Low State of Health.—Insulate the patient upon the static platform with direct metallic connection to the positive pole of the Holtz machine. Ground the negative pole. If the patient is still in a very feeble state, give only simple positive electrification for ten or fifteen minutes daily for the first few *séances*.

As soon as discretion permits, add three minutes' breeze to the head and the same to the spine at each sitting, with the brass point electrode in gentle waving motion, and at a distance to make the application most agreeable. Use only a mild non-irritating breeze; and if the clothing of the patient is such as to make the negative breeze unpleasant, stop the machine and change the platform rod to the negative pole and administer the positive breeze of less potential.

Repeat daily until improvement is so far advanced that three

times a week will be sufficient to continue until strength is fully established.

When the early improvement has progressed to the point of willingness on the part of the patient to receive other applications, a few mild sparks at each sitting should be applied to the spine and to the muscles of the limbs. The exercise thus given to the muscles rapidly imparts tonicity and strength. Usual restorative remedies may be given at the same time, and no means neglected to hasten recovery, for electricity never interferes with the action of medication. Among various means at the physician's command to shorten the tedium of a slow convalescence probably no other agent exceeds electricity in value.

In these cases also the author's method of potential alternation, vibratory massage is one of the most effective tonic administrations. It is advisable to wait a few days before employing it so that the patient may become thoroughly accustomed to the static machine and recognize its benefits.

As long ago as 1777 we find Cavallo recording the belief that "electricity assists the innate endeavor of nature to restore the sound state." To this useful function I shall now devote a few moments' consideration.

If it is the first consideration of therapeutics to prevent disease, it is certainly of almost equal importance to repair its ravages.

It seems to the writer that on too many occasions we are content with relieving pain, reducing temperature, carrying our patients through acute crises, operating brilliantly, or employing chiefly those palliative measures to which the limitations of our science unfortunately often restrict us. The rest we are prone to leave to nature. Indeed it has been well said that the "triumphs of medicine thus far have been in alleviating pain and in the prevention of disease, rather than in the cure of actual and active morbid processes."

But to all classes of cases—the child delayed in resuming its mental and physical training for future work, the son or

daughter about to enter business or society, the business man in enforced detention from his active interests, the workman losing his needed wages, the wife or mother on whom the home depends—to all these alike the period of convalescence, of reconstruction, possesses an enormous material importance.

The sequelæ of acute and short-lived diseases often prove more tedious and disastrous to the patient than the initial invasion. States of anæmia, of deficient innervation, of organic and functional debility, of lessened tissue resistance, are created which unfit the individual for the duties of life, or render undue exertion dangerous, and out of which the slow processes of imperfectly aided nutrition conduct him with faltering and leaden step. Relapses occur which renew and prolong anxiety, and when recovery is complete (?) there may or may not be the fullest possible restoration of anatomical integrity and the processes that maintain sound health.

I need mention no more than the frequently protracted convalescence from typhoid states, from influenza, from pneumonia, from scarlet fever, diphtheria, or dysentery to call to the mind of the observant practitioner an endless procession of illustrative cases.

So, too, in many chronic cachexias, whether the cause is removed or not, "vitalization of tissue is what these patients need." They need fortifying against toxic attack. For obvious reasons the specialist, surgeon and consultant, does not usually concern himself with hygienic and general measures directed to the ultimate removal of the effects of the disease which no longer exists, or of any cause which he has employed his special skill to eliminate. This is the province of the physician, and in a great measure his success in practice will be proportioned to the care with which he finishes up the tonic treatment of his cases.

It is now my intention to pass over the familiar tonic agents, because we all know them, and to speak of one of great value, but as yet too vaguely appreciated in general practice.

It is one of the curious phases of medicine to-day that it often reserves the aid of electricity till all else has failed, till organic lesions have obliterated nerve cells and nerve fibres, both functionally and structurally, and then demands that electricity, to prove its power, shall, in effect, "reconstruct an organized animal tissue from its ashes." I shall not debate the question of whether this medicinal agent can create something out of nothing, life out of local death, for only its opponents seem to expect that; but it is my purpose to refer in brief to one of its humbler yet still valuable properties.

Says a prominent teacher of therapeutics: "One characteristic and almost invariable effect, due to electric stimulation of the peripheral nerves and their end organs, is the improved nutrition of the patient. It is a matter of common observation in a clinic, where the poor are treated by electricity alone, and in a great variety of methods, local and general, that they make a rapid increase in weight and general health, irrespective of the progress which may ensue in the disease for which they are under treatment."

Indeed the latter may be an incurable one, but we can often treat the patient when we cannot successfully treat the disease, and even in such cases the results may be exceedingly gratifying. Phthisis, in its first and second stages, is a case in point.

In a paper read before the Neurological Section of the American Medical Association, another authority states: "It has always seemed to me that the most important thing in the use of electricity in medicine, the fundamental idea upon which all its therapeutics is based, is its nutritional power."

My own experience for several years devoted especially to the uses of medical electricity has afforded me ample proof of the correctness of the above views; and I may say in passing that I value the services of this agent far more for its utility in a thousand practical every-day cases than for its power to partially benefit an advanced stage of some rare or incurable lesion of the central nervous system.

In the widening range of currents now offered to the expert in electro-therapeutics there is an opportunity to select our methods according to our case.

Local applications for specific local purposes are not here referred to by the author, although certain local methods extend their influence into the general nutrition; but of the effects of what is known as general electrification, whether by galvanic, static, sinusoidal, or faradic coil currents, I propose to speak particularly.

They are all valuable tonics. In convalescence they may be considered alterative, tonic, and restorative, capable of doing excellent service unaided by drugs, and more directly in the line of hygienic and climatic influences. If bodies in low states of health are found to be negatively charged, then the positive charge (which is the rule in health) derived from the static machine is in the nature of a change of climate, and in fact is quite often as beneficial.

The pre-eminent place in nutritional effects may be allowed to the constant galvanic current when the "central nervous system" is principally at fault and degenerations have occurred; but when the debility is rather muscular, circulatory, or functional, then my preference is for an interrupted current capable of producing a powerful impression on the peripheral nerve filaments and stirring to their depths the trophic centres.

In September, 1893, I described a new method of administering an interrupted (oscillating) static current, and it is this method, originated by me, which I employ in the large class of cases requiring an energetic re-invigoration of vitality.

Administered without the removal of any of the patient's clothing and involving no tedious technique, I nevertheless regard it as an efficient substitute for the D'Arsonval "high-frequency bath," and for most other forms of general electrification.

If direct muscle massage is indicated the static spark is demonstrably one of the most effective methods of producing

it, and we have but to add its local influence to my general administrations to secure results of a pronounced character. Regarding the muscular contractions produced by the local spark as a gross massage of the tissues, it is considered that in the general vibratory administration of a rapidly alternated potential we subject the constituent particles of the tissues to an insensible molecular massage, the benefits of which are apparent in the vasomotor system, in better circulation, in increased excretion, in better oxidation, better sleep, more cheerfulness, more vital energy—in short, in an increased functional stimulation and in general progressive improvement.

This is just what we want in convalescence from acute prostrating diseases; just what we want also in every case of lessened tissue resistance when restorative measures are indicated and are practicable, even in diseases like diabetes, Bright's, and phthisis.

In chlorotic conditions, amenorrhœa, and derangements of schoolgirls, especially if a legacy from earlier illness which is not outgrown, the nutritional value of electricity is of very great importance.

It is vastly more useful, I repeat, when freely employed, as it should be in these cases, than when reserved for advanced stages of lateral sclerosis and spastic paraplegia.

It is a sovereign tonic in the debility of old age and in the vast range of so-called "female weaknesses" for the same reason that it serves us in convalescence. If individuals in general, of any age, were "finished up" through complete convalescence to the fullest possible restoration of strength by those whose skill was not found wanting in the acuter stages of disease, there would be less prevailing anæmia, less neuralgia, less "nervous prostration," less dysmenorrhœa, less headache, and less poor eyesight in men and women; less hysterics, less dyspepsia, less disappointment in life, less surrender to the invasion of microbes, less catarrh, less phthisis, less insanity, less crime, less suicide.

I am accordingly an earnest advocate of nutritional remedies during convalescence and in every depressed state in which they are admissible. Not second in value to cod-liver oil, the hypophosphites, phosphorus, iron, or arsenic, but a useful adjunct to them all, will be found the administration of some form of medical electricity.

The profound restfulness and comfort produced by vibratory potential alternation elicits many expressions of satisfaction from patients. Employed conjointly with other indicated therapeutic and hygienic measures in debilitated states, I know of no method of electrical treatment preferable to it in many cases. In either acute exhaustion, fatigue from worry and work, brain and eye fag, or more chronic conditions of debility, neurasthenia and anæmia, it is extremely useful.

Chronic Effects of Shock.—Sudden fright, narrow escape from fatal injury, business calamity, and other causes not infrequently produce a condition of shock which long leaves the nervous system unstrung and in a state of asthenia.

In these cases the sedative-tonic and restorative influence of static electricity does for the patient what no other agent known to the author can so well effect. It is the remedy *par excellence* for morbid fears, debility of the sympathetics, hypochondriacal, melancholic, brooding and deranged states, from above causes.

If anæmia, constipation, and indigestion coexist prescribe the remedies indicated, but the outdoor diversions which would benefit these patients are often reluctantly regarded and the tendency is to neglect them. The chief coercion upon the shattered nervous system must be exercised by some means independent of the person's will.

One of the best agents for this purpose is static electricity. It seizes hold upon the nervous forces, occupies them, diverts them, engages their whole attention, and by mild and gentle compulsion directs them into natural channels of action and restores their natural strength.

Seat the patient comfortably on the static platform connected with the positive pole. Ground the negative pole and administer simple positive electrification for fifteen minutes at the first sitting. After a few treatments in every case, and at the very beginning with others who feel no undue timidity, a positive head and spinal breeze may be added to the simple electrification.

When improvement has well advanced so that the nervous startings have been outgrown and composure and endurance have somewhat returned, the principal muscles of the body may be exercised by mild sparks.

As soon as these can be given with agreeable toleration by the patient the improvement is more rapid, and general nutritional and restorative processes soon terminate the need for further treatment.

The headaches and insomnia which trouble most of these cases are among the first symptoms of the condition to disappear. The treatment should be repeated daily at first and follow the usual rule as benefit progresses.

These unfortunates, whether men or women, are frequently left to time to outgrow their infirmity, and it takes a long time to do it. They are not considered invalids and they encourage themselves in the belief that they do not need any medicine, but they are more or less unfitted for their regular duties, and their enjoyment of life is considerably diminished.

With a knowledge of the good effects of static electrification no physician is justified in neglecting to give any case of this kind the benefit of so valuable a therapeutic measure.

Chronic Effects of Heat Prostration.—As the victims of sunstroke or heat prostration survive with morbid susceptibility to future heat exposure, and are often for many years afflicted with neuroses traceable to this cause, it is gratifying to know that the electro-therapeutist can do much to palliate or even remove the condition.

Positive static electrification for fifteen minutes about four

times a week for a period of two or three months will do much to restore the system to endure the heat of the following summer.

Supplementary methods for sedative-tonic effects should be selected and applied, according to the judgment of the physician, in the management of the particular case. The head and spinal breeze and mild spark will be useful in many cases, but no routine method can be pursued.

Personal experience illustrates the value of static electricity as a restorative after the acute stage. One patient of mine who could not venture into her own kitchen four years after her attack without suffering, made good improvement under positive electrification supplemented by the spinal breeze.

For the headache which is usually a feature of these cases, and also for the mental asthenia, administer a positive head breeze, regulated in strength to comfortable tolerance, for several minutes at the close of each *séance*. When applied by means of the stationary electrode request the patient to gently move the head from side to side and rotate it slowly so as to direct the breeze upon every portion of the cranium.

Nervous Chill.—Chills from exposure to cold and even the chill of ague have all been aborted or speedily ended by me by the application of static sparks.

The regulating tendency of static electricity upon the circulation and temperature of the body is very marked, and is always one of the first things that attracts the attention of patients coming to the office in cold winter weather and in a state which they declare to be "half-frozen."

It accomplishes the warming process in a manner which seems peculiarly to gratify these patients, and which differs very much from the effects of a stove, hot-water bag, a hot drink, or a stimulant. It in fact does not act as a stimulant or as external heat but as a regulator of the internal functions to normal.

Ground the negative pole and the brass point electrode to the

gas fixture. Connect the patient with the positive pole of the Holtz machine. Start the plates into medium action, which, if the power is an electric motor, will soon increase in speed as the resistance of the circuit diminishes. Commencing at the spine, apply a strong, warming rubefacient spray up and down the back, across the abdomen, and over the lower extremities until the body is in an agreeable glow. Discharge occasional sparks from the electrode by sweeping it nearer the person.

If the patient is accustomed to the treatment and not afraid of sparks exchange the point for the brass ball electrode, reverse the polarity of the platform, and apply a few single thick and long sparks to the soles of the feet through the shoes, to the muscles of the legs, and to the spine.

The warmth that follows this vigorous application is curative of the chill, unless the cause is the invasion of an inflammatory disease, in which case, of course, the failure of the current to produce any but temporary effects is at once diagnostic and medical measures are indicated. There is no reaction, however, in the class of cases to which static electricity gives practical curative relief and the method is remarkably satisfactory.

Enuresis. —When this yields to ordinary remedies it is useless to consider electricity in its treatment; but as at times all medication seems to fail, one of the simplest and best alternative methods, requiring no exposure of the person, is the application of mild static sparks to the spine and perineum. Good results have been recorded after a few treatments in some very intractable cases.

The Value of Tonic General Electrification in Chronic Interstitial Nephritis and Chronic Catarrhal Cystitis.—A case of this kind among others in my recent experience was as follows:

Mrs. ——, aged 48, neurasthenic, anæmic, and hyperexcitable, consulted the author for relief from intercostal neuralgia supposed to result from an injury two years previous.

Treatment: Positive electrode, 2x2, over pain anteriorly,

negative *ditto* to back of neck. Constant galvanic current, ten milliamperes for ten minutes, raised for two minutes during each *séance* to fifteen and twenty milliamperes, maximum, as tolerance increased.

Also simple positive electrification on static platform for ten to fifteen minutes. Sittings three times a week.

Relief to all symptoms began with the first application; returns of pain became lessened in both frequency and severity. Iron was prescribed for the extreme anæmia at the end of the first week.

The improvement in her nervous condition, sleep, energy, and composure was so rapid that in one month she felt better than in five years before and her friends all remarked how well she looked.

Up to this date nothing directed attention to special organs. She next called with report of foolish exposure to cold and wet in investigating the effects of a furious winter storm the day before. She complained of severe pains in the lumbar region and the situation of the kidneys. This was completely removed by an application of a high-tension rapidly interrupted induction-coil current and a specimen of urine was procured.

The pathologist's report of the examination stated the diagnosis of "chronic interstitial nephritis and chronic catarrhal cystitis."

As these conditions were not previously known, the case illustrates the beneficent nutritional effects of static electricity in the treatment of patients, even when it is not assumed that it treats some special disease which the patient may have.

This lady continues to feel better and I believe that in many cases of Bright's disease, diabetes, and chronic inflammations of the bladder, the action of other remedies would be most efficiently aided by the auxiliary tonic action of static electricity.

CHAPTER XXXIV.

IMPAIRED VOICE OF SINGERS—DEBILITIES OF THE AGED.

Pharyngitis, laryngitis, voice fatigue, or hoarseness of singers and speakers. Rapid relief afforded by high-tension currents. Method of treatment. Results of treatment. Clinical cases. Results in a chronic and incurable case treated with static electricity. The debility of old age and chronic invalidism. Immense value of static electricity to these patients. Methods of employing its usefulness. Its benefits long-lasting.

Pharyngitis, Laryngitis, Voice Fatigue, or Hoarseness of Singers and Speakers.—In these cases, where the trouble is chiefly congestion or fatigue of the vocal apparatus and the voice becomes thickened and husky or loses in any respect its tone or controllability, both the high-tension induction coil and the static machine afford excellent methods of treatment.

If the static machine is used I insulate the patient negatively and send a few sharp, thick positive sparks to each side of the larynx, with the patient's chin well up and turned to the opposite side. Use care to avoid sparking the chin or the sensitive regions of the upper part of the chest. Next apply a few similar sparks to the cervical spine. An alternative method employs Leyden jars.

Place the small Leyden jars in circuit and press an ordinary hand, sponge-covered electrode moistened with hot water to each side of the larynx externally. Place the sliding poles of the static machine in close contact. Start the plates into rapid action and draw the poles gradually apart until the muscular effect is as strong as possible without producing discomfort or preventing the patient from swallowing and breathing.

During the passage of the current put the vocal cords into

action by requesting the patient to practise deglutition, inaudible sounds, or even the vocal scale aloud.

After from three to five minutes of this continuous application of an anti-congestive, sedative-tonic current through the vocal apparatus reduce the dosage about twenty per cent and then institute a series of rising current waves, by suddenly increasing the spark gap to the utmost limit of tolerance and instantly decreasing it again.

Twenty or thirty such rhythmical impulses may be sent through the tissues in two or three minutes. Then let the machine come to a gradual stop, and while the spark stream loses its high frequency there will be a gentle exercise of the throat muscles as the interruptions of the current become slower and slower till they finally cease.

Repeat as needed in acute cases, relief being very speedy. In chronic cases the first sittings should be daily, with later repetitions regulated by the circumstances of the case.

The Leyden-jar method is a favorite with the author and achieves such gratifying results that patients as a rule are delighted. As a means also of preserving a failing voice which is still the owner's dependence for support, this tonic application repeated for a few times as often as the need arises would put off the evil day for a long time. From operatic stars to choir singers, and from dramatic and political to pulpit orators, there are many who would rejoice to know of so valuable and swift a remedy for any temporary strain upon the voice. If the throat specialist has anything to offer in similar cases that can compare with the efficacy of this method I am not aware of it.

To the worried and alarmed singer, fearful of pecuniary loss and unable by desperate efforts to command the vocal cords, the static electrodes appear to be the wonder-wands of magic. The current, however, simply relieves congestion, restores tonicity to the muscular fibres, and the voice revives again. In such cases also, whenever the general health and especially

the nervous system is below par, the *prima donna* or the humble but necessary singer in the chorus or choir, may easily receive the usual benefits which positive static electrification bestows upon all who require its tonic action.

Chronic Voice Fatigue.—Mr. D——, aged 50, sings in a choir regularly. Has done so since boyhood. During the past year or two has noticed that his voice has begun to show wear. He was treated with the Leyden-jar method, which I generally employ instead of the sparks. The immediate improvement in his voice was noticed by his choir leader the next day. He was treated a few times with increasing improvement and when his voice fails again he will return.

He was not only delighted but surprised at the remarkable benefit which his voice obtained so rapidly and so easily, and he remarked, as others always do, that if persons who use their voice as a means of support were aware of the existence of such a practical remedy for functional derangements they would all be glad to utilize it.

Mr. S——. Acute laryngitis of mild form with partial aphonia. Could hardly talk above a whisper and voice was so husky that he said he thought he had "caught cold." He was treated for five minutes in the usual manner, with the rapidly interrupted high-tension current and as he then appeared able to talk with very nearly a natural voice no other treatment was given. Two weeks later he returned with a recurrence of the same cold from exposure to wet weather and the same treatment acted as before.

The following relates my experience with a chronic and probably incurable case.

Miss ——, aged 20, anæmic, had adenoids removed two years ago. Has a chronic catarrhal pharyngitis, has been hoarse since she was about three years of age. Has no special symptomatic derangement. Has been taking vocal exercises from a celebrated music teacher, who assured her that he could cure her voice, but the strain makes it worse.

She has been treated locally and generally in a number of different ways by different physicians, but her voice, at the

time of her coming to me, was extremely husky and possessed very little power. It was a source of mortification to her, and treatment was begun with general static electrification and continued with alternations of both the spark and Ledyen-jar current to the larynx.

After the earliest application she felt a choking sensation, which presently passed off, but benefit did not begin to appear until the fifth treatment. At the tenth treatment the voice was much less guttural. On the sixteenth visit she appeared as hoarse as ever and had myalgia of the right shoulder, the effects evidently of a sleigh-riding party which she had partici pated in two days before. The static application removed both the myalgia and the extra hoarseness.

At the eighteenth visit she appeared to have gained considerably, her voice was much clearer and she was pleased and hopeful. At the twenty-second visit my entry reads: "Voice improves steadily, cannot do scales without the current as it chokes her, but with the electrodes applied and the current passing she can practise scales loud and clear; is very much better."

At the twenty-ninth treatment her voice was quite smooth and clear, she could take high notes with the aid of the current very well, and she concluded that her total improvement was equal to about sixty per cent.

Between the 19th of January and the 6th of April, 1894, she received thirty-eight applications, during which time she sometimes improved and sometimes relapsed. She then went abroad for a year and on returning I learned that the improvement had remained about the same. During the middle portion of her treatment a few intercurrent applications of a mild galvanic current were administered to relieve the monotony of action upon the tissues.

The following case reported by Dr. Caldwell expresses in a few brief words the ordinary experience of physicians who possess static machines:

About two years ago a prominent baritone singer was sent to me for electrical treatment, suffering from paralysis of the right vocal cord. My treatment consisted of negative sparks on the cervical region for five minutes and on the larynx for four minutes. A few such applications restored the vocal cord and his voice to their normal condition.

The Debility of Old Age and Chronic Invalidism.—Cases

occur in the experience of every physician in which some restorative influence is needed beyond the resources of drugs, food, and rest, to fit the patient who is stricken with disease in advancing years to escape from house confinement, get out of doors, and once more resume the ordinary habits of comfortable if not entirely vigorous old age.

Some of the most estimable men and women in both public and private life cease their activities before their time because of imperfect convalescence from sudden and brief illness. In many cases there is no lack of means or desire to procure every aid within the resources of medicine, and I therefore suggest one measure, rarely utilized as it might well be, but not surpassed in its comfort-giving and strengthening properties by any of the tonics of pharmaceutical art. It is within practical reach of many families who would gladly avail themselves of so simple and effective a means of benefiting the objects of their solicitous affection, if their physicians but brought it to their notice.

I would recommend in all such cases the employment of static electricity as a general nutritional agent—mild and agreeable in its action. At but a moderate cost the family can purchase a six-plate twenty-six-inch Holtz machine and have it set up in the apartment of the invalid, who can then daily enjoy its subtle and far-reaching benefits under the direction of the medical adviser.

Even when the patient is too feeble to rise from bed the couch can be insulated on glass supports, a chain from the prime conductor can be passed under the covers to the patient's hands, and positive electrification administered for fifteen minutes, twice a day.

Long before the feeble invalid would be recuperating under ordinary treatment sufficiently to endure a much-needed drive in the sunshine and bracing air, the static machine in his own room could be strengthening muscles without taxing the weak heart, revitalizing the nervous system, and serving as a most

admirable substitute for the exercise that cannot yet be taken.

If sleep is deranged the sedative influence of the soothing head breeze or an application to the cervical spine can be invoked at bedtime. If rheumatic, muscular, or other pains, and symptomatic disturbances occur during convalescence the skilful application of some form of static current will nearly always give general relief.

Whatever building up of the tissues can be done by usual remedies may go on hand-in-hand with the daily use of static electricity and will be promoted by it. The remarkable facility with which this high-potential therapeutic resource may be employed in sustaining and restoring the feeble powers of the aged of either sex is a strange *terra incognita* to the vast majority of physicians. The medical mind, familiar only with minor faradic therapeutics, or perhaps acquainted in general with the limitations of both faradic and galvanic methods of technique, may well be surprised at the radically different capabilities of the modern Holtz machine.

No case of the kind here considered can be regarded as receiving the fullest benefits of scientific medicine until properly directed static electricity is added to the extra-drug therapeutics of the attending physician.

Nor will the usefulness of this tonic agent end when the patient is again able to take part in the affairs of life, but daily throughout the remaining years vouchsafed in this world it may be employed with continuous satisfaction and benefit. Speaking from personal observation of the good effects of proper methods of static electrification in the infirmities of the aged I cannot too strongly advise the use of so helpful a remedy in assisting to smooth the pathway, and comfort and sustain in mind and body the closing scenes of those veteran pilgrims whose stay on earth exceeds the psalmist's limit, often by many years.

CHAPTER XXXV.

THE CONTRA-INDICATIONS OF STATIC ELECTRICITY.

Aggravations by static electricity. Aggravations shown to be unnecessary with careful regard to proper indications.

THE thoughtful consideration of every physician is invited to this phase of the subject of medical electricity.

When the indications for selected methods of electrical treatment are properly understood, and an intelligent idea of contra-indications is obtained, a great step is taken toward rational therapeutics.

It is one of the misfortunes attending the lack of undergraduate instruction in electro-physiology that many patients to whom the resources of medical electricity would be an inestimable boon are deprived of its beneficent action through erroneous medical advice. There is certainly no other branch of therapeutics which suffers so much injustice through lack of information concerning its actual merits. The utmost conservatism has guided the author in his statements in this book covering the therapeutic action of static electricity. Extreme care has been taken to eliminate every word of extravagance, and probably twenty-five per cent could be added to the majority of the author's remarks in behalf of this valuable agent without exceeding the limits of absolute adherence to fact.

This being the case, it is a matter of great regret that the entire medical profession is not so well informed upon the physiological action of all electric currents as upon the actions of leading drugs.

While the indications for different forms of static electricity

cover the general range of usefulness set forth in the chapter on physiology, yet the contra-indications are seldom concisely stated. They are as follows:

General Electrification.—A careful study of the action of general electrification upon the pulse, temperature, respiration, and secretions demonstrates that there is no state of the tissues in which it would be essentially injurious—there being no state of disease in which a regulation of the functions to normal is contra-indicated.

Clinical experience demonstrates that general electrification acts without harm, and with benefit, in all diseased conditions amenable to curative treatment, whether they are acute or chronic, febrile or the reverse.

General electrification will not benefit perceptibly a person who is already in sound health, and patients who exhibit any of the conditions which prevent office visits do not present themselves for static treatment; hence these are *negative contra-indications.*

Positive contra-indications to general static electrification can hardly be said to exist, for it produces no injurious effects upon the human system. It is as harmless in acute inflammations as in chronic diseases, although medication supersedes it for various reasons.

The Static Breeze.—Contra-indications can hardly be said to exist for purely sedative forms of the static breeze. These can have no possible injurious effects, and the only contra-indications can refer to the fact that when other measures are needed it would be a waste of time to employ an application which was not the most effective that could be used.

Passing from the sedative to stimulating, rubefacient, and counter-irritant forms of the breeze, it suffices to say that both indications and contra-indications conform to the general principles of medicine, and do not differ because the agent which produces these effects is an electric current instead of a drug formula.

The Static Spark.—The great contra-indication for powerful static sparks is the same which forbids mechanical violence of any other kind. There are, however, modifications of the static spark, so that contra-indications undergo equal modification; and in many cases of disease, when the pressure of the hand cannot be borne without pain, a mild static spark will allay the pain, restore local nutrition, and bring about symptomatic relief in many cases, and an entire cure in some cases. This is common clinical experience.

Leyden-Jar Currents.—If it be granted that the operator conforms the application and dosage to the therapeutic requirements of the case it can almost be said that positive contra-indications do not exist. A strong current is of course contra-indicated when a weak one is required, a slowly interrupted current is contra-indicated when the physiological effects of a rapidly interrupted current are sought, an application with labile electrodes may serve in one case while another case would require that the electrodes were stationary—and so on through all the gradations of electro-therapeutic administrations, we may balance one method against another, and finally find that there is scarcely a patient who could not be treated in some way by some form of static electricity without harm and with more or less benefit.

The harmlessness of this agent when applied with due regard to indications cannot be too fully understood by the medical profession, however some may regard the demonstrated clinical results. It is reassuring to feel that there is no risk whatever in treating a patient whom we may not feel certain of doing decided good, but whom we should be very reluctant to harm in the slightest degree.

For many years statements regarding the dangers of other electric currents have crept into medical literature and serve to influence the majority of the profession to apply the same reasoning to static electricity.

Many of the authors who wrote in former days would now

employ improved apparatus and would revise their statements if they were living.

In a popular work on the subject of electro-therapeutics published in 1888 the author of it refers to the indications for "galvanism" in a certain disease and speaks of "faradism" in the following manner:

> Whenever the mistake has been made of using faradism in ——, serious loss and injury have been suffered. The prime need is for a sedative, and directly opposite in effect is the induced current, which but adds fuel to the fierce flame of disease. It should never be employed in this disease, not even as an application to parts distant from centres.

The lamented author of the work in which this now obsolete paragraph appears was on the point of revising it when he died. *The sedative effects of improved high-tension induction coils represent one of the distinct advances in electro-therapeutic apparatus since 1888.*

I have now a report from a physician who has successfully treated a case of the same disease referred to above with the modern sedative induction-coil current. It ought to be generally recognized that the contra-indications which definitely apply to a particular battery, or current, or dose, or method, or to maximum administrations, may not apply to different currents, different apparatus, and intelligent modifications in scientific electro-therapeutic treatment.

Aggravations by Static Electricity.—Once in a while some writer reports that static electricity aggravates the disease. He means, rather, some form or dosage of static electricity, and generally the spark—which is contra-indicated in conditions in which mechanical violence is contra-indicated, but which is not seldom ignorantly employed, both when it should not be used and in ways that it should never be used; for the spark can easily degenerate from a valuable therapeutic measure into mere brute force.

Moreover, the spark is by no means the whole of static elec-

tricity. I once knew an old lady who was fond of stating that "she did not like fish." She also claimed to "like meat." On careful inquiry in regard to particular kinds of these foods I found that she admitted the ability to eat with relish six individual kinds of fish, and really liked only three different kinds of meat. When the spark is not acceptable with relish (therapeutic benefit) almost the whole field of static electricity is still left from which to choose a form of application to suit the case.

In one of the opening chapters of this book I have shown that a prominent electro-therapeutist of national reputation and since deceased, stated in 1892 that he "had abandoned the static spark as a pain-killer, believing that in a majority of cases, no matter how skilfully handled, it is as apt to aggravate as to relieve."

Such statements mislead the uninformed physician. It is impossible to regard them in any other light than as a declaration on the part of every such writer that he has not carefully studied electro-physiology and the action of the percussive spark, and has not been guided by indications, but has applied the spark without regard to indications. Mere skill in the manipulation of an electrode does not offset the injurious effect of setting up a violent perturbation in tissues that are moaning for soothing rest.

Practically speaking, I never aggravate a patient with static sparks. It is needless. I never fail to advance with caution in the treatment of every state of doubtful pathology, and every strong spark that I administer has had predecessors to make a reconnaissance with milder force. At the first sign of a contra-indication I stop the spark, but I know so well in advance when sparks will do good and when they will not that my experience with even momentary aggravations has become exceedingly limited.

However, when a pathological state protests against a tentative spark, a brief application of the sedative breeze immediately removes the first and last vestige of irritation, and there

ends the aggravation. I cannot conceive the possibility of my persistently hammering away with strong sparks at sitting after sitting upon tissues that were indicating by every possible means they could express the use of some other method.

The therapeutic principles are too simple and clear to justify any such procedure. If the operator errs through ignorance at the outset of his experience, as he sometimes errs in the dosage of drugs, he should strive to learn better by studying the subject.

CHAPTER XXXVI.

PARALYTIC DISEASES.

Wry-neck, paralysis agitans, tremors, etc. Methods for general constitutional benefit in incurable cases. Paralysis. Varieties. Prognosis. The practical results obtainable with static electricity in both curable and incurable cases. Principles of treatment.

Paralysis Agitans.—Static electricity will not cure these diseases under ordinary circumstances, but if the patient's general health is below par and the condition is thereby aggravated, static electricity will always afford the amelioration attendant upon an improvement in health, and in some cases a good deal more.

I have treated an elderly and neurasthenic woman who had suffered from paralysis agitans for thirty years, and whose handwriting was barely legible, and after seventeen administrations of static electricity have seen her improve in general health, regain nerve tone, and write a letter which was about as steady as persons seventy-five years of age in ordinary health would be able to write.

The methods employed and proper in all such cases are simply those which will improve the general condition and relieve any other local symptoms which may exist, pain, etc.

The main part of the benefit is derived from positive electrification, and a tonic breeze to the spine and centres of the cranium. If the arm muscles are flabby and weak from lack of exercise I add slow muscular contractions with an interrupted current for the purpose of increasing the tone of the fibres, and this usually ameliorates in some degree the tremor or agitation.

Paralysis.—The physician has already books upon his shelves which enter into the minutiæ, classification, and sub-

division of the different forms of paralysis. I shall simply attempt here to formulate the guiding principles of treatment which apply to static electricity. No other measures which will benefit the patient should be neglected, and static electricity will not interfere with anything else that is done.

Its function is twofold: to improve the patient's general health if this is impaired, and to assist in restoring the abolished muscle function of contraction.

The second part of its usefulness involves an interrupted current, and there are two forms which may be employed—the static spark and Leyden-jar currents.

The prognosis in cases of paralysis is subject to much greater variety than the methods of treatment.

Paralysis may be due to:

(1) Loss of contractility in the muscle itself.

(2) Loss of cerebro-spinal centre ability to cause contraction.

(3) Interference in the nerve trunk by disease or injury with the exercise of the muscle function in response to the volitional centres.

The resulting paralysis may be complete or partial, and may affect a single muscle or extensive groups of muscles.

With respect to prognosis it may be said concisely that when the loss of power is in the muscles, and the centres and path of conduction are unimpaired, almost every case can be either rapidly or slowly cured.

Something of the results will depend upon the skill of the operator, the faithfulness of the patient in attendance for treatment, and the methods employed. I have seen a case of facial paralysis following a middle-ear operation advance rapidly in my own hands and show more improvement after fifteen treatments than he had obtained from a year and three months of treatment elsewhere with a different current and an aimless method.

In all cases of mechanical injury to the nerve trunk the prognosis will be good if the anatomical integrity of the nerve is

either maintained or can be restored. Any injury which destroys the path of conduction obviously renders a cure impossible. The same remarks about prognosis apply equally to disease of the nerve trunk.

The great class of cases in which many ignorantly and in vain look to electricity for a "cure" includes all those dependent upon injury to the motor centres. What static electricity can do for these forms of paralysis is practical and useful, but not miraculous.

If the patient comes to the office from confinement in the house, with a nervous system shattered by either suffering or anxiety, with muscles wasted by lack of exercise, and the whole body in a weak state, the immediate effects of general positive electrification and mild positive sparks to the spine and muscular surface in general will relieve pain, promote sleep, give passive exercise to the muscles, renew vigor and tonicity, and in two weeks' time produce an apparently remarkable change for the better.

As a matter of fact this simply *begins* the treatment of the paralysis, and it is after this point is reached that disappointment, founded upon a lack of information, ensues. The *patient* has been benefited by lifting his general system up to the level of his actual disease, and treatment has simply removed the debilities of house confinement and his previous sufferings. The actual treatment of the paralysis dates from this time.

The prognosis depends upon three things:

If the central lesion is an effusion which will reabsorb, or an injury which time will make better, the prognosis will be a gradual improvement in proportion as the central impediment disperses. These cases of hemiplegia and paraplegia can be improved with great satisfaction by electrical exercise of the muscles, while, if left to time alone, the paralysis would long linger after the effusion was absorbed.

If the central lesion or injury is of a character which retrogrades, the road before the patient is all down hill, and elec-

tricity can produce only temporary benefit, or assist the patient to be more comfortable if the paralysis is attended with suffering.

If the injury within the head or spine has reached a maximum of damage and thereafter remains in a chronic quiescent state, the patient will, if left to time, witness a very gradual improvement, and perhaps, after many years and a great variety of medical treatment, reach a point where his muscles are useful in proportion to the existing state of the central cells and fibres.

If such a patient is properly treated by electricity before the chronic effects settle into complete apathy far better results can be obtained in much less time.

If atrophy has taken place and is complete, the galvanic current provides much better means of rousing the function of contraction than does the static spark, but in all cases of paralysis the proper thing to do is to find out which current awakens the most ready response and employ it. The applications of galvanism to paralysis are sufficiently well known and these remarks will be confined to static methods only.

The minor forms of paralysis due to cold should be first treated by a warming, relaxing, anti-congestive application of a rapidly interrupted small Leyden-jar current upon the same plan as that which secures faradic sedation with the modern high-tension induction-coil apparatus. Following about five minutes of this application, exercise of the muscles may be gradually developed by interrupting the same current at the rate of about seventy times per minute.

Caution is always advisable at the commencement of each case to avoid overtaxing weakened muscles by too vigorous stimulation. Short sittings, with slow and mild contractions at first, can be gradually increased in the amount of exercise until the muscles endure very thorough treatment without fatigue.

If the paralysis results from lead, gout, rheumatism, hysteria,

syphilis, or any form of constitutional poisoning, the best application is persistent, oft-repeated, and thorough nutritional and alterative treatment with static sparks, together with iodide of potassium, mercury, and other drugs (as severally indicated) to neutralize the poison and eliminate it from the system.

It is, however, often astonishing to witness the improvement in cases of mineral poisoning in patients who attend the clinic and who receive no medicine whatever.

After the first general improvement, in central types of paralysis which will either improve slowly or present atrophies unfavorable to treatment with static sparks, the general administration for nutritional effects should be continued, but the local exercise of the muscles may best be carried on with a slowly interrupted Leyden-jar current and the application of a pair of ordinary moist electrodes.

In some cases this would involve a removal of garments which the crippled patient cannot easily remove in an office, and in these cases substitute methods must be employed until improvement reduces the extent of the crippling and makes more thorough treatment possible.

When the arm is affected it is comparatively easy to bare part of the surface, wind a chain around it, and exercise the muscles by the author's method described in a previous section.

In estimating the value of static electricity in all cases of paralysis it must be remembered that its sphere of action relates chiefly to its influence upon functions and that it is not possessed of properties which will supply new nerve cells, remove a cerebral clot, repair the ravages of a chronic inflammation, cut down excessive formation of connective tissue, or prevent mechanical pressure upon vital structures.

If the treatment of any form of paralysis is undertaken with static electricity, and the patient is able to attend for office treatment, it is certain that there is no stage too early to properly begin. A great part of the damage done to the multitude of cases we see in general practice was done by long waiting

for inflammation to subside and by other delays which put off the application of electricity. The longer a muscle is deprived of its functional activity the more it wastes and the longer it takes simply to regain the unnecessary loss.

In the acute stage of apoplexy from cerebral hemorrhage I would unhesitatingly advise affording the patient the benefit of a daily administration of a sedative, anti-inflammatory, positive head breeze to reduce the cerebral hyperæmia, as soon as he could be safely allowed to move about and attend for treatment. It would also act as a sedative-tonic, and aid in maintaining the tonicity of the entire system, so that when the time arrived for exercising the paralyzed muscles he would have suffered the least possible amount of physical and mental degeneration. Notwithstanding that no opportunity has been permitted me to put this view into actual practice, I nevertheless believe it to be thoroughly advised. I also believe the application of galvanic currents to the head in an attempt to absorb a clot to be fruitless for good and a dangerous practice.

In the latter part of this book will be found the history of a large number of cases of paralysis treated by methods which conform closely to the present use of static sparks. Every physician will do well to study them carefully, but they are not to be considered a criterion of the full capabilities of static electricity to-day. The older electricians did not indeed altogether limit their treatment to the paralyzed muscles, but their apparatus was far less effective than the present Holtz machine is in the great influence upon nutrition and general functional processes which now forms so large a part of the benefit of static treatment.

CHAPTER XXXVII.

WRITER'S CRAMP.

Typewriter's and Telegrapher's paralysis—acute or chronic fatigue of special muscles. Massage methods of little value. Treatment of the early stage of writer's cramp with complete cure. Treatment of middle stages with symptomatic relief and either marked improvement or entire cure. Treatment of paralytic stage of writer's cramp. Results obtainable. Treatment of cramp and spasm. Author's complete experience with different phases of writer's cramp. Successful treatment possible in many cases.

THE author has devoted considerable time and study to the treatment of these irksome affections. In chronic cases of true writer's cramp rest is not even palliative. I have seen telegraphers who could not touch a key even after rest of from one to sixteen years. The ordinary therapeutic suggestions of text-books are practically useless. Some method of exercise, or wrist appliance, or massage may serve to relieve a few cases, but others "try everything" and despair at last.

Owing to an increasing infirmity in my own arm I examined, in 1893–94, into the merits of every treatment described during the past thirty years. I can discover no authentic method which will cure writer's cramp in the brief period of two or three weeks, nor can any method be discovered by me which will enable the patient to successfully treat himself at home.

Much has been claimed for methods of specific massage which were described by a German writing-master in 1877, but after personal interviews with him in this country, and witnessing a demonstration of his method, it has been impossible to verify his alleged results. It is probable that his method is valuable to himself, but unless others are able to obtain the secret of his technique it will be difficult to place a definite estimate of value upon the Wollf method. It seems, however,

to be a treatment so laborious and tedious as to be wholly unsuited for use by the physician himself.

"Electricity" has been vaguely recommended for writer's cramp by various authors, but in actual practice has been nearly always wrongly employed, even by distinguished neurologists, and especially by those who have utilized old forms of apparatus and coarse faradic currents. No other medical agent suffers so much from bad methods as does electricity, but when employed skilfully in the manner which I shall here direct it is deserving of more confidence than any other plan of treating the above affections. This conclusion is based upon personal experience.

Commence treatment by instructions as to diet, nutrition, personal habits, muscular exercise of the arm, and hygiene; and prescribe remedies to relieve anæmia, neurasthenia, or any existing condition which keeps the general health below par. The exercises for the arm should be of a general nature to improve the strength of large groups of muscles and should not involve an extra tax upon the small muscles whose co-ordination is affected.

The varieties of conditions which progressive stages present require different local treatment, and all local treatment must be engrafted upon constitutional measures.

Early Stage of Easy Fatigue with Disordered Sensations.—Current: The general nutritional properties of static electricity may be employed by either positive electrification, or breeze, and mild sparks, for constitutional effects. The local treatment of the arm is accomplished with either a rapid interrupted small Leyden-jar current, or by a rapidly interrupted high-tension induction-coil current from the author's improved apparatus.

Technique: Place a flat, sponge-covered electrode of about twelve square inches surface on the upper spine over the roots of the brachial plexus. Connect it with the positive pole. Press the flat palm upon a similar negative electrode. Pass a fine, nutritional, rapidly interrupted high-potential current for

three minutes. Increase dose from zero to a strength just causing a pleasant general thrill along the arm without producing muscular contractions or fatigue.

Then shift the positive electrode to the middle flexor surface of the forearm. Let the weight of the arm rest upon it with the extensor surface uppermost. Take an ordinary hand sponge-covered electrode, moisten it in warm water, and lubricate with soap. With the same current as before, just strong enough to act decidedly upon motor points without fatigue to the muscles, pass the hand electrode with rapid movements up, down, and over the entire extensor surface of the arm and hand, producing gentle passive exercise of each group of muscles by action upon the motor points, and general nutritional effects throughout.

Change the positive electrode to the posterior forearm and repeat the same effects upon the flexor surface. About five minutes to each surface is sufficient. By study of the muscular action and reaction under the electrical stimulus determine the muscles most needing treatment, and exercise them particularly.

Repeat *séances* daily for about two weeks, and thereafter as may be required. When done correctly with the proper current and dose the result is increased lightness, comfort, buoyancy, elasticity, speed, and endurance. These good effects begin with the first sitting and progress in permanency. If improperly done, the arm aches and is tired after treatment.

Later Stage of Distress in Arm, Pains, Sense of Heaviness, Quick Fatigue and Weakness.—Repeat the same treatment as in the preceding stage. At the close of each sitting change from the rapidly interrupted current to slow interruptions of about seventy per minute, increase the strength sufficiently, and for a few minutes cause slow, painless but strong contractions of all the muscles between the shoulder and wrist, omitting the hand.

In this and all later stages of writer's cramp there are usu-

ally two special conditions demanding attention. Make deep pressure with the thumb upon the flexor and extensor sides of the forearm over nerve trunks and motor points to detect areas of *local tenderness.*

Treat each spot found by long fine coil, or Leyden-jar sedation, until the tenderness is relieved. Press the positive pole over the tender point, place the negative opposite, and pass the current directly through the tissues until sedation is complete. It will require perhaps three or five minutes at each sitting until the condition is permanently overcome. The current should be interrupted with the maximum of rapidity, and the strength gradually increased to full tolerance, and at the close of the application reduced very slowly to zero before removing the electrode. The electrodes are held in one position during the application.

The second condition is *deficient synovial lubrication* of the tendons of the wrist and hand. Some distress in the parts may also be present, but this is relieved and synovial lubrication at the same time restored by the same tonic sedation applied to the upper points of tenderness. After the stabile application is, made the negative electrode should be rapidly whipped over the surface a few times for quick circulatory and muscular effects to relieve any sense of heaviness caused by the preceding method.

In cases which have not progressed beyond these stages the relief is marked, the arm "feels natural," abnormal symptoms are speedily removed, and the usual amount of work can be done with comfort after from two to four weeks' treatment.

The hand may not become so good as before it failed at all, but it is restored to practical satisfaction, and if it relapses in time under continuous use it should be treated again. The operator should also avoid overtaxing it and always work within his speed limit. In this way the hand can be kept in working condition for years. The best prophylaxis is moderation in regular working speed.

Paralytic Stage.—When loss of power becomes the most pronounced symptom, and speed and strength no longer respond to the operator's will, the method of treatment may commence with the plan above described if indications are present, but treatment must also include attention to the paralysis.

The electrical reactions of the muscles will be found to be slower than those of health. They contract and relax gradually instead of quickly. Restoration involves the long, slow treatment of chronic paralysis, and is altogether a different matter from the treatment of earlier stages of chronic fatigues only.

The muscles of the arm and hand may be stimulated by either the galvanic, faradic, or static currents if either is properly applied with proper apparatus.

Home treatment with the cheap type of faradic battery is usually injurious, and never curative.

The nutritional effects of the constant galvanic current, positive electrode on the cervical spine, negative water-bath electrode covering the entire hand, with several slow reversals during a fifteen-minute *séance*, may be employed as an intercurrent treatment. The dose should be about ten to fifteen milliamperes.

When an interrupted high-potential induction current, or an interrupted galvanic current, is employed to exercise the muscles by slow contractions, the rate should not be greater than about seventy periods per minute, and the current strength and duration of sitting should be short of causing pain, fatigue, or distress of any kind, during or after treatment. My own special method of treating this stage of writer's cramp is as follows:

Seat the patient on the static platform with the sleeve of the affected arm rolled up. Immerse the hand in a deep jar water-bath connected with one pole of the static machine. If the season of the year or activity of the machine makes the current exceed tolerance with positive electrification the jar should be connected with the negative pole, which gives a milder con traction. The positive is preferable, however, and by slowing

down the machine until the muscles develop sufficient tolerance to accept more powerful contractions the dose may be regulated to the proper degree of comfort.

Ground the opposite pole. Also ground the brass ball electrode and by regularly interrupting the positive charge by sparks between the prime conductor and the electrode cause slow and restorative contraction of all the muscles of the arm.

The interruptions by the spark should be about sixty per minute, with numerous periods of rest during a ten-minute application, so that the after-effect is never fatigue but is always an ever-increasing feeling of buoyancy and strength.

The electrode must be judiciously manipulated by the hand of the operator and not fixed on a standard. Beginning with mild sparks the current may be gradually increased by making the machine revolve faster.

A reasonable time within which to expect a fairly established improvement is three months, but frequency of treatment will have a good deal to do with the matter. It will also make a great difference whether or not the patient is able to rest during the period of treatment. In many cases the occupation which affords the only means of living cannot be stopped and this interferes seriously with the rapidity of improvement.

Coincident with the local treatment by this valuable method is also the general constitutional benefit which is imparted at the same time by applying a few static sparks to the spine and general muscle surface of the body before closing the sitting.

The Stages of Cramp and Spasm, and also Total Disability.—If these are mild, occasional, and occur only after excessive work has produced extreme fatigue, they will disappear during the treatment of the general vasomotor and trophic disturbances or the paralysis, by the methods described above.

If tonic cramp seizes the wrist or finger muscles almost at the outset of the day's work the prospect of cure is less hopeful.

If the cramp follows the first attempt to use the pen or telegrapher's key, and does not relax in a moment but speedily

grows worse so as to totally prevent the use of the hand, the prognosis is unfavorable, although partial improvement may be obtained.

In these cases the arm is often affected with pains, numbness, or other sensations which impair sleep and render the patient uncomfortable even when writing or telegraphing has been suspended. These symptoms can be relieved and the arm restored to normal comfort very readily by high-tension-current tonic sedation, and if the person ceases the occupation which fatigues the arm a course of three months' careful treatment will also greatly improve the powers of co-ordination.

It is, however, difficult to "cure" the total disability stage of writer's cramp so that regular work can be resumed and maintained. I have never been able to conduct a case in this late stage to a satisfactory conclusion, possibly for the reason that such patients have not persisted in treatment. It is noticeable that the victims of this affection desire to be "cured" more rapidly and with less trouble than persons who are afflicted with some other chronic diseases, and they become more impatient perhaps because it is so universally understood that they are incurable. I have attempted a variety of sedative and antispasmodic methods of electrical treatment for severe and persistent cramp, but as none have proved curative it is useless to describe them here.

The best results appear to be obtained by simply continuing for a much longer period the methods that afford relief in the earlier stages. In treating writer's cramp the physician must be competent to adapt the electrical application to each case, and no two cases are exactly alike. An expert knowledge of the disease is fully as important as a knowledge of treatment.

Non-use or modified use of the affected arm is of course desirable during treatment, but in most of the cases treated by me the patient was obliged to keep at work, often, however, substituting the left hand for the right.

When the left arm has been mildly affected after total loss

of grip of the right hand it has rapidly regained full power under treatment, even when no special relief from daily work was obtained. The treatment of the left arm under these circumstances relates almost invariably to the early stage of the disease, and consequently the prognosis is good.

As a matter of fact there would be no such thing as actual writer's cramp if all persons were properly treated in the acute stage, for the advanced symptoms could be warded off indefinitely.

Of the efficiency of a single sedative-tonic application of a rapidly interrupted, high-potential current to remove the immediate results of muscular fatigue, I have had many evidences in clinical experience.

An Acute Example.—The typewriter who is copying this MS. for me began to work at her most rapid speed for seven hours a day after being without practice on the machine for nearly three years.

At the end of the third day's work her shoulders were pretty lame and her right hand ached intensely through the palm, from the strain upon the muscles caused by spacing entirely with this hand. To quote her own words, she felt "as if every word she wrote would be the last she would be able to do," and her hand was, in fact, completely worn out.

When a condition of this kind is aggravated by day after day of overtax at high-pressure work it results in the condition known as writer's cramp. This lesion is not the effect of slow and deliberate work, however long such work may be continued, and almost every operator whose arm gives him trouble can point to the time when some extraordinary task proved to be the last straw which broke him down.

An application of positive static breeze was made to the aching shoulders of the young lady I am referring to, and the local application to the muscles of the forearm and hand occupied about five minutes' time. The relief experienced was absolute, and the hand has never bothered her again. The single application took away the sense of fatigue, the ache, pain, and distress, and during the thirty days of hard work which followed she had no further need to repeat the treatment.

It is certain that nothing in the way of rest, lotions, massage,

or any other forms of procedure can take an exhausted group of muscles in hand and transform them into a state of natural comfort and functional activity so successfully as the method described above.

Experience confirms the conclusion that the methods pursued by me in the treatment of these cases will restore almost all cases of writer's cramp in the early stages.

In the middle period of the affection the arm can be improved and thereafter kept in fair working condition by repeating treatment from time to time as the need arises. Attention to the arm for a few weeks each year would defer paralysis indefinitely.

It is not necessary to consider the prospects of a radical cure, for if a means of recuperation is available whenever the arm begins again to fail, it will enable the operator who does not again overtax his arm imprudently to use it so long as he pursues the vocation. In the advanced stages of actual and severe cramp the patient must usually change his vocation and be satisfied with the relief of distressing symptoms, if any such exist.

As my investigations indicate that about thirty thousand persons in this country suffer from some form of occupation neurosis at the present date, in the various stages from preliminary symptoms to complete loss of power, the importance of a means of relief is obvious. As no means of cure of the final stage has yet been discovered, it is plain that all persons whose income depends upon an occupation producing writer's cramp should heed the first signs of fatigue and unusual sensations and preserve their arm by proper treatment when "one stitch in time saves nine."

CHAPTER XXXVIII.

MISCELLANEOUS CONDITIONS.

Dyspepsia and functional derangements of the alimentary canal. Limitations of static electricity in these cases. Its benefits in nervous and reflex dyspepsias. Cases reported. Conclusions from clinical observation. Acute fluent coryza. Effect of the head breeze in establishing immediate relief. Precautions after static treatment to avoid taking cold. Toothache. Immediate and lasting relief afforded by the sedative breeze. An illustrative experience. Sore and bruised gums following dental traumatism. Relief of pain by the static breeze. Cerebral hyperæmia. Clinical experience with the appreciation of patients who have been treated by static electricity. Lateral curvature of the spine. Methods of treatment. Infantile paralysis. Static electricity subordinate to galvanism. Sprains and contusions. Acute and chronic. Beneficial action of static applications. An illustrative case.

Dyspepsia and Functional Derangements of the Alimentary Canal.—Constipation, diarrhœa, colic, nausea, and pain are all relieved by local static applications as I have shown elsewhere, but curative effects relate chiefly to cases in which these symptomatic disturbances are reflex or functional.

Dyspepsia may be limited to mean nothing more than a troubled action of the stomach, which can be restored to normal by toning up the nervous system, the secretory glands, and muscular fibres of the digestive apparatus. This whole improvement, involving a stimulation of circulation and the re-invigoration of nutritive forces, is well within the physiological action of static electricity.

The direct application of a static spray or spark upon a catarrhal inflammation of the surface of the body will often heal up the process, but such general administrations as can be applied to catarrhal states of the alimentary canal are not effective in curing such a form of dyspepsia. As a rule almost all cases of gastric derangement are treated by other therapeutic meas-

ures, but static electricity will do no harm in any case, will help the majority of cases, and therefore aid the action of other remedies, and in nervous cases it is one of the best possible methods of treatment.

If there are soreness and stiffness in the abdominal muscles, or any reflex or neuralgic pains, these symptoms are quickly removed, with very great satisfaction to the patient. If the digestive trouble is due to a lesion, either more difficult to cure or entirely outside the range of static action, we may greatly reduce the reflex irritability and increase the tolerance of the patient so much that the exciting cause creates far less disturbance than formerly.

Lajoie * published a report of sixty observations of dyspepsia which he had treated by electricity, from which the following is taken:

CASE I.—A young man, aged 27, Mr. L——, came to me in 1892, having been troubled for the last two years with more or less heaviness in the head. There was no pyrosis, no gases were belched up. There was no vomiting or nausea. The bowels were regular, though at times somewhat costive. But what the patient came to me was for this, a symptom which I was unable to find mentioned in the books I have read on dyspepsia, viz.: almost every night he felt a soreness over the abdomen. Pressure would neither increase nor diminish the soreness, but change of position would. This would be felt from two or three o'clock in the morning until half an hour after rising. The soreness caused uneasiness and sleeplessness. Meals were taken regularly and did not distress him nor cause any trouble; apparently digestion was good.

After a thorough examination, and I must add some hesitation, my diagnosis was: Intestinal nervous dyspepsia.

After a fourteen weeks' treatment with static electricity he was perfectly well and has remained so up to three days ago, when I last saw him. The positive pole was connected with the stool and the negative used to draw the spark, commencing with the pointed electrode, then gradually coming to the one with the large ball—the sparks increasing in intensity as I went along.

* Journal of Electro-Therapeutics, October, 1895.

CASE II.—That of Mr. S——, 30 years old. After examination and history of the case, I concluded to give him Ewald tests, with salol, iodo-potassium at his next morning's meal, and examine him an hour after. The man was rather thin. After examining the stomach I was surprised to feel the cardia hard under my hand, then gradually that hardness went on as a wave toward the pylorus; one could *see* the peristaltic action of the stomach.

The tests showed retardation of digestion. After ten weeks of electrical treatment the man was well and digestion normal.

CASE III.—Mr. H—— sent for me, August 10th, 1895, for heart disease. For the last three weeks he had been unable to sleep more than a few minutes at a time, his heart *thumped so hard.*

No organic trouble was found upon examination of the heart. Gas was belched up frequently. This patient was living on milk, oatmeal, and the like. I gave him as a diet the whites of two eggs beaten in spring water, five or six times a day. Positive static electricity as treatment was given every day for the first week, then every other day.

In twelve weeks that man could eat and digest steaks, chops, etc., and his heart caused him no more trouble.

CASE IV.—Mr. E——, aged 26. Food takes a long time to properly digest; gas belches up; nausea recurs frequently; no vomiting; bowels irregular; headaches often; pain in the back along the spine, and obliged to urinate very often, but it is painless. Rides the bicycle often.

Faradic current with coarse coil was given, positive pole over the stomach, negative in the lumbar region. I made this patient stop riding his bicycle, and with the electrical treatment he was made well in eight weeks.

I will limit my reading of observations to these, but will now present a few conclusions:

1. In every case of dyspepsia, static electricity will cure or help to cure. Even a case of cancer of the stomach has been greatly benefited by this treatment.

2. Neurasthenia or hysteria manifesting themselves by dyspeptic symptoms are always cured or benefited by electricity.

3. Electricity has the effect of stimulating the general nutrition.

4. It has the effect of correcting any insufficient or perverted innervation of the stomach.

5. Of regulating, first, the action of the glands of the stom-

ach, and second, the hydrochloric acid in the stomach, lessening it when the quantity is too great, and increasing the amount when too little.

6. Give treatments from five to fifteen minutes' duration, beginning with small doses, gradually increasing them as the benefit is greater, until the maximum beneficial dose is reached. The state of the patient being your *meter*.

7. When nutrition is disturbed, electricity has the special effect of bringing it back to the normal, and that result never fails when there is no irreparable anatomical lesion.

8. Electro-therapy, in every disease where the nervous system is a factor, will help greatly, if it does not itself alone affect a cure.

Acute Fluent Coryza.—Seat the patient upon the platform connected with the negative pole. Ground the positive pole and also connect it with the breeze electrode adjusted at a comfortable distance above the frontal region. Maintain the plates in moderate action, or sufficiently fast to produce a vigorous but agreeable breeze. Repeat several times as may be needed.

The serous discharge from the nose will usually stop in a few moments, but the patient should continue the application for at least twenty minutes. If the after-conditions are favorable to prevent a repetition of the cold from exposure after the treatment, one administration is a wellnigh infallible cure, as I have observed for a number of years in my personal experience and as it was stated to be by the electricians of the last century.

Precautions after Treatment.—Some physicians keep their office very warm and some patients wear very warm clothes. When these conditions are combined with an energetic application of static electricity a sensible perspiration is set up and should be allowed to subside before the patient goes out into an atmosphere which is liable to cause her to take cold. Aggravations sometimes occur from this cause and especially when the patient steps from the office to a street-car and is subjected to draughts. Ten minutes of rest in the reception-room is a wise precaution in every case in which perspiration has been induced.

Toothache.—Seat the patient upon the static platform with

connection to the negative prime conductor. Ground the positive pole and the brass point electrode and apply a strong, sedative, positive spray to the area of pain upon the side of the face. Apply the same principles as in treating ordinary neuralgia of the face. It would hardly be expected that this would give more than a few hours of relief to the pain of a carious tooth, and it was so stated a hundred years ago by the men who employed it then. I am not a dentist, but when a tooth is decayed so badly that the end of a lead pencil could be inserted in the hole the fact is sufficiently apparent to my eye to leave little doubt in the matter.

Some three years ago a cook in my household had two or three such teeth which gave her a great deal of trouble. She had a natural horror of our dental friends, and could not be induced to have the tooth repaired until it set up such a paroxysm of ache that she at last consented. As she was in too much agony at the moment to endure the thought of going alone I applied a positive spray to the side of the jaw for about fifteen minutes.

As the pain completely ceased she changed her mind about the dentist and said she would wait until the tooth hurt her again. This did not happen until three months later, when the same process was repeated. She was in my employ for two years, and in this case and others I have found the relief afforded by the static breeze surprisingly permanent in some very badly decayed teeth.

Sore and Bruised Gums Following Dental Work.—In some half-dozen instances patients of mine have happened to come directly to my office for treatment after leaving the dentist. Sometimes the process of filling a number of teeth has produced a general ache. Sometimes one, two, and in one case six teeth have been pulled out, leaving the gums in an intensely painful condition. None of these patents had received any local sedative from the dentist, but were sent home to let time heal the wound.

The positive breeze directed carefully upon the gums has in every case produced a state of comfort, and at the same time tranquillized the entire nervous system. No one who has not personally experienced the relief afforded by this simple application could credit the change it makes. Of course no electrical current which requires the contact of electrodes could help these cases, nor is any anodyne or mouth wash quite comparable to static in its effects.

Cerebral Hyperæmia.—The relief of this condition is afforded by the same means as the treatment of congestive headaches. If, in these cases, the scalp is very sore and tender, and even the weight of the hair is felt to be an intolerable burden, the positive static head breeze will produce immediate beneficial effects. Frequency and repetition of the treatment must be governed by the intensity and persistence of the hyperæmia.

Clinical Remarks about the Appreciation of the Patients.—In my experience in the practice of medicine I have observed no other branch of practice in which expressions of appreciation and wonder are so often spontaneously made by patients during treatment as in the field of electro-therapeutics. It is true of all currents, and especially true of a well-handled static machine.

Almost every report made by different writers remarks the same fact. Many of the expressions of patients would be regarded as the extravagance of hysterical enthusiasm by sober-minded practitioners accustomed for years to dispense the routine remedies of the materia medica. They often excite ridicule among persons who read the printed remarks and are totally uninformed about the cause of the sufferer's gratitude.

To every one, however, who has long operated a static machine these expressions from patients who have entered the office in a miserable state and have gone out with a light-hearted sense of comfort become commonplace and routine. They excite neither surprise nor comment, and the few that are

reported are very much short of the thousands that are not reported.

The reluctance of the individual mind to admit that any medicine does any good is well known, and is encouraged by statements from teachers high in authority who seem to have no confidence whatever in any branches of medicine except surgery, pathology, and diagnosis. *Therapeutics*, however, must come in somewhere or the medical profession has no ground to stand on, and static electricity is one of those Napoleonic and masterful therapeutic remedies which emphasizes its benefits in an unmistakable way.

This book, however, omits everything in the way of an attempt to repeat any of the remarks which patients are accustomed to make after some extraordinary symptomatic relief. The basis of confidence in static electricity is a careful study of its physiological actions rather than the remarks of the laity.

Lateral Curvature of the Spine.—A sufficient number of static sparks to produce satisfactory results in exercising and toning up the deficient muscles in this affection would be annoying to the patient, and a better way is to produce regular muscular contraction by a slowly interrupted Leyden-jar current.

A well-moistened sponge or felt covered electrode about the size of the palm may be maintained by the patient upon the abdomen, while with an ordinary hand electrode the operator exercises the entire muscular area of the affected side, upon the general principles involved in the treatment of all forms of paralysis.

The abdominal electrode may be connected with the positive Leyden jar, the interruptions adjusted to about seventy per minute, and the current strength made sufficient to first cause very mild contractions, and gradually increase to cause more vigorous and powerful effects, as the muscular fibres increase in both strength and endurance.

When the affection is limited to the muscles only, this is

the best method of treating lateral curvature. It can be supplemented by any reasonable forms of exercise, and other measures directed to improving the general health. Static is *facile princeps* in these cases.

Infantile Paralysis.—When this is of the form which follows poliomyelitis, and the leg muscles, for instance, below the knee are completely atrophied and will not contract to an induction current, the treatment of the paralysis must be begun and long continued with galvanism.

While, however, static electricity will do little or nothing for the atrophied and useless muscles, it will give passive exercise to the muscles above the knee if they are not paralyzed, and to the muscles of the other leg, and increase the control of the patient over the limbs. As this exercise can be readily given with a few static sparks and general improvement promoted by local applications to the spine without removing any of the clothing, it is often a very useful procedure. Static electrification will also do much to improve the general health.

Sprains and Contusions, Acute and Chronic.—If the static application can be applied immediately, the repair of the tissues, in even very severe cases, will be greatly hastened. Insulate the patient with the negative pole, ground the positive pole and the brass point electrode. Sweep the point gently over the uncovered skin of the injured part at a distance of a few inches so as to give a strong spray. This will instantly remove the sense of heat, pain, and tension; it will reduce the swelling and produce comfort at once.

I have had no opportunity to judge what the full capabilities of this treatment would be if it could be repeated often enough to maintain the good effects. Unquestionably, however, no other means in the hands of the surgeon can approach the static breeze in the kind and quality of work it does in these cases.

If the patient goes home and does not have more than the first treatment with static electricity the subsequent management of the case upon ordinary surgical principles will be

greatly facilitated even by the single treatment. If she returns from time to time the reparative processes of nature can be advanced, and subsequent stiffness of the joint removed, more satisfactorily by electricity than by other means. The following is a recent case which illustrates the value of both X rays and the static breeze and spark:

Mrs. ——, aged 45; weight 180 pounds. Under treatment for chronic articular rheumatism of the hip-joint which she has had for eleven years. On December 30th, 1896, while on the way to my office she stepped from a street-car upon a treacherous pile of snow, which gave way beneath her, and in attempting to save herself she fell with her entire weight directly upon the thumb, which struck the ground upon the end.

Although a stout, muscular woman, she was so severely bruised by the hard fall that she was unable to proceed for half an hour. When examined, the thumb was already much swollen, acutely painful and throbbing, very hot, and discolored around the middle joint, which was almost "telescoped" by the force of the blow. The end of the thumb was bruised to a pulpy state but the skin was not broken.

A positive static breeze continued for about ten minutes entirely removed the heat, throbbing, and pain. It stopped the whole inflammatory process, reduced the swelling, and restored comfort.

An examination with the fluoroscope showed that the bones were intact. As she lived a distance from the city she was given a sedative lotion and sent home to her family physician. The thumb was so badly injured that he suspected some splintering of the bone of the second phalanx, but she confidently disputed his diagnosis with the statement that she "had seen the bones herself with the X rays and they were all right."

On the 2d, 6th, 8th, and 10th of January she had other static applications upon the thumb, which was rapidly undergoing improvement. No very severe pain returned at any time and each application removed whatever pain was present. The effect of the spray in restoring circulation through the injured vessels was very marked. No part of the thumb became black and blue, the numbness and stiffness were about all that needed treatment after the first two weeks, and a few mild sparks had good effect upon these. In less than two months from the time of the injury she ceased to pay any further attention to the thumb.

CHAPTER XXXIX.

MISCELLANEOUS CONDITIONS.

Locomotor ataxia. Static electricity treats the patient rather than the disease. Its great practical usefulness. Principles of treatment. Static electricity probably the best single remedy for general effects. Treatment of symptoms. Selection of indicated methods. Routine treatment avoided. Treatment for different stages of the disease. Prognosis. Functional derangements of the genito-urinary organs in the male. Static electricity as an adjunct to local treatment. Static electricity in infancy and childhood. Clinical case of infant seven weeks old. Clinical case of infant eighteen months old. The power of static electrification to arouse functional processes.

Locomotor Ataxia.—Static electricity can hardly be said to treat locomotor ataxia. *It is, however, of great efficiency in the treatment of a patient who has this disease.*

I believe it to be of much greater efficiency than writers accord it, but I refer to static electricity as a whole, with *all its therapeutic and physiological resources,* in the hands of one who applies it according to its indications, instead of the perfunctory routine of static sparks.

If the possessor of every Holtz apparatus in this country was properly instructed in the technique of static administrations and exercised reasonable judgment in considering the indications for different methods, it is probable that many more cases of locomotor ataxia would receive substantial instead of merely temporary benefits.

In order of importance the treatment of this disease is based upon the following measures: "(1) Rest; (2) nutrition; (3) removal of reflex disturbances; (4) drugs directed against the lesion."

Static electricity comes very near to covering the last three

of these indications, except so far as specific medication may be required for a specific cause of the sclerosis. I leave to others, however, the theoretical discussion of how best to "cure" this frequent disease of the spine, and will simply state the manner in which I treat patients who come to me suffering from locomotor ataxia.

Most of the patients who finally reach the office of the electro-therapeutist are somewhat advanced in ataxia and have already decided that medical treatment could not cure them.

If there is no specific history there is almost no occasion to prescribe other drugs, and I depend entirely upon galvanic and static treatment, with ordinary personal hygiene. It appears probable that at some stage of the processes within the spinal cord the galvanic current may accomplish what static electricity certainly will not; but it is hard to decide what goes on in the spinal cord.

For the relief of symptoms, and local and general nutritional effects, my main dependence is static electricity, and patients learn to look to it with more confidence than to any other form of treatment they have ever received.

It may be said in passing that the clinical history of some ataxic patients shows a wide range of experience in the hands of different neurologists, and some of them become very expert in deciding what makes them feel better. It is very rare to find an exception to the rule that static electricity holds the first place in their affections.

Omitting references to methods of applying other currents I will proceed to static electricity, and say that there is no stage of the disease in which it is contraindicated, or in which it cannot contribute something to the patient's comfort. Although I follow no routine, but meet the condition which each patient presents as seems to be indicated at the time, it is necessary to write of the matter in some systematic way, even if this involves arbitrary division of the disease into theoretical stages.

Whatever symptoms present themselves in the first stage of locomotor ataxia, which is presumably limited to congestion and other changes which precede the sclerosis, they should be treated upon the same principle that the same symptoms would be treated in any case not locomotor ataxia. The spine is not to be thumped indiscriminately with powerful static sparks because the diagnosis points to this disease.

One of the best methods of treating congestion and advancing stages of inflammation is the sedative spray. Peripheral applications of the spray, mingled with mild sparks from the brass point electrode, will do a great deal to relieve pains which are associated with conditions which call for sedation rather than the mechanical violence of the percussive spark.

It is in more advanced conditions of sclerosis that sparks to the spine are indicated, but the whole treatment of locomotor ataxia with static electricity practically resolves itself into treatment of symptoms and endeavors to maintain functional processes and nutrition.

A promise to cure the disease must be left entirely out of the question; but in saying this I do not mean to imply that any other agent administered for the same ends would accomplish more. *Posture during treatment is important.*

It naturally follows that the operator who expects to produce satisfactory results with this class of cases must understand all forms of technique and know when to apply them.

When the spinal condition is recent and requires sedation the breeze is indicated. When it is chronic and needs stimulation, a stimulating breeze, spray, and spark present different modifications for use. If the head aches, the positive breeze will remove it. When the organs of the trunk are severally involved, the same principle of spray sedation (if muscular soreness, tenderness, or other signs contra-indicate the spark) applies to them; while if the condition is chronic and needs stimulation the spark is well tolerated and beneficial.

Some patients have scarcely any pain at all, and some find

pains their chief trouble. If these pains are burning and throbbing and originate at any definite point, I concentrate a good deal of spray in the indicated locality before using sparks. If the pains shoot from place to place and have no settled habitation, their relief goes along with the general nutritional treatment which is the main part of every sitting.

This treatment embraces the whole nutritional resources of static electricity as described on another page, with the particular addition of an extraordinary number of sparks upon areas of numbness, pain, or anæsthesia, including the soles of the feet.

What would be intolerable to an ordinary patient will only initiate an agreeable sensation to the ataxic individual, whose legs below the knees are heavy and numb.

It is considerate, in all cases, to begin every powerful spark treatment with a preliminary warming up with milder measures, for when the circulation is well established and the patient composed by a few minutes' rest on the platform he will be better prepared for energetic measures.

In every case it is my custom to advance to powerful sparks only after the tentative employment of milder measures, and by this plan I am enabled to say that I have never aggravated the symptoms, irritated the patient, or made him less comfortable.

On the contrary, it is the rule that the patient sleeps better, feels a decidedly beneficial muscular reaction and steadiness, maintains a greater degree of comfort, and does not appear to go down hill so rapidly; he is inclined to think that static does him more good than anything else he has ever tried; he may even for an indefinite time improve; the process may seem to be arrested; he may seem to be cured; in some cases he is finally able to go entirely without treatment for several months or even a few years; in other cases he is only able to keep fairly comfortable when he takes static regularly at greater or less intervals, sometimes once a week, sometimes twice or three times a week.

In other cases (and these are a small minority) the patient is a negative sort of individual who thinks nothing ever does him any good, and after a little while he drops static also.

The effects of specific medication are too well known to need mention here. One of the chief difficulties in estimating the value of static electricity in chronic cases of this character is the fact that patients are often treated at wholly inadequate intervals, with more or less irregularity, and sometimes by inadequate operative skill. Nine-tenths of all that appears in medical literature about either the uses or limited value of static electricity in locomotor ataxia may be rejected by the physician of to-day who possesses an improved Holtz machine and who knows how to use it.

Functional Derangements of the Genito-Urinary Organs in the Male.—It is sufficient to state that in this class of cases static electricity will either act as a sedative nerve tonic, or a stimulating nerve and muscle tonic when either the local or general condition indicates such measures.

The mental condition of patients who brood over their trouble will be greatly improved, and in cases which are either functional or organic, static electricity will prove decidedly useful if the general health is below par, as it usually is.

In addition to other forms of administration, which would follow ordinary rules, the single special method requiring mention is sparks to the perineum. These require some little knack to administer, and for this purpose the spark electrode enclosed in glass is useful although not absolutely necessary.

Static Electricity in Infancy and Childhood.—The diseases of children which do not belong to the epidemic affections or to the acute inflammations are for the most part of a functional nature. In the latter class of cases children are susceptible to improvement by the action of remedies which regulate the functions and improve nutrition.

It is not my intention to suggest any substitute for ordinary medical procedures, but there are times when the mother is

very anxious, and the physician would not intentionally deprive her of any remedy which would help her child. In marasmus and conditions of extreme prostration, hyperexcitability or dangerous apathy of the nerve forces, the static machine may be a boon in thousands of cases. The tonic effect of seashore air to children who are prostrated with summer heat in the city is not more pronounced and decisive than the benefits of positive static electrification.

A child of any age above a couple of weeks old can be safely held upon the static platform in the arms of either a nurse or the mother and subjected to general electrification without alarm or conscious sensation of any kind, and without undressing. The mother's feet should rest upon the metallic foot-plate connected with the positive pole and one hand should hold the bare hand of the baby, so as to make direct connection without intervening resistance. If the child is held around the body and outside the clothes the current will pass through to the infant in the form of a small spark, and probably result in tears.

H. B——, aged 7 weeks, bowels loose, has been very ill; bottle-fed baby; has had acute diarrhœa for three days; will not sleep, cries all the time, and the mother is greatly alarmed. Medication has failed to establish an improvement.

September 11th, 1896: The mother held the child upon the static platform and both received ten minutes of positive insulation. On the 14th she came back reporting that the child had slept three hours immediately on returning home, and had since been quieter and the diarrhœa had ceased. On the 16th the child was seen to be improving rapidly with no other treatment than static electrification, of which three treatments had now been administered. The external application of cod-liver oil was begun, with an internal auxiliary remedy, and under the joint influence of these and two more static applications the child improved considerably.

The baby weighed nine pounds at birth and only ten pounds at eight weeks old. On October 2d he was brought to the office again and showed signs of intestinal irritation. Both mother and child were given fifteen minutes of positive static electrification and a change was suggested in his diet, since which time he has grown well and hearty. The efficacy of the

static administrations in arousing the nutritive processes is certainly useful in all such cases. The mother was also very much run down, and it was as much benefit to her as the child.

Upon the first visit the baby cried continually and was almost uncontrollable at first, but quieted down a good deal under the soothing influence of the current. At subsequent visits he was perfectly quiet and showed the usual appreciation of the static machine.

L. H——, 18 months old, has been sickly for a long time. Her mother has had four previous children and never succeeded in getting any one of them past the age of one year and one-half. The baby was extremely emaciated and the cachectic state was considered due to worms. The mother was frightened and crying from the belief that her child would soon pass away, and both were put upon the static platform connected with the positive pole. This was at the beginning of February. Medication was of course prescribed for the case and the mother instructed to examine the stools. Nothing was discovered to confirm the diagnosis, and the remedies were changed to cod-liver oil externally and a simple aid to digestion. After the first administration of static the child immediately ceased to get worse. She was treated only three times a week during the month of February, 1897, and before the middle of March has now become a comparatively active and hearty child.

When static electricity is administered to infants they often sleep during the entire process, especially after the first sitting. If the current was administered every day for a time it would probably do them much more good, but if it arouses a reaction even when administered at longer intervals, and enables other remedies and home treatment to attain their desired results, it is worth employing.

It appears to me that in desperate cases it would often turn the tide in the child's favor by its undeniable restorative action upon the forces which energize the vital organs and carry on the processes of nutrition.

CHAPTER XL.

STATIC ELECTRICITY IN GYNECOLOGY.

Its local and general usefulness. Amenorrhœa. Method of static treatment. Chlorosis and anæmia. Method of treatment. Relief of symptoms and neurotic disturbances in these cases. Static electricity and menstruation in general. Menstruation not a contra-indication for sedative forms of treatment. The benefits of general electrification in mild cases of dysmenorrhœa. Cervical and lumbar backaches of women. Static electricity almost a specific remedy. Methods to employ in treatment. Gynecological wrecks. "Nerves." The effects of general electrification. Static electricity in puberty. Static electricity in pregnancy. Its great value to relieve the symptomatic disturbances during gestation. Contra-indications considered. Convective-discharge methods always harmless during pregnancy. Mental states. Clinical experience with the beneficial action of static electrification during the entire progress of pregnancy. Static electricity during the menopause especially indicated in this state of functional derangement. Its superiority to drug sedatives. Clinical remarks upon practical methods of treatment. Uniform efficiency of apparatus essential to uniform results. Three tests for determining the normal maximum of current from any static apparatus.

No attempt will be made in this section to suggest the uses of static electricity in every separate lesion of the pelvic organs. It treats the patient rather than the disease, and the indications for its use do not follow classical nosology, but appeal to the eye of the operator when he examines the case or present themselves in the history.

Sound general health is rarely associated with chronic disease of the uterus. If any patient is below par she needs general as well as local improvement. As an auxiliary to the pelvic uses of galvanic and faradic currents, the nutritional and tonic effects, the sedative nerve-composing, pain-relieving, and muscle-strengthening properties of static electricity are invaluable to the patients of the gynecologist.*

* As is well known the indispensable currents in the local treatment of pelvic disease are those obtained from high-tension induction coil and galvanic appara-

In the backaches of women, in simple dysmenorrhœas, at puberty, during gestation, throughout the menopause, in neurotic disturbances, neuralgias, headaches, cold extremities or hot flashes, prolapse, endometritis, fibroids, with all their pains and reflex symptoms, in the anæmias, neurasthenias, and dyspepsias of these states, static electricity will add immensely to the benefits of local treatment, and single-handed will provide an amount of comfort for invalid womanhood which medical means could not equal in any other single way.

When it is a nerve sedative it is not a depressant of nerve force; when it relieves pain it does not cut down vitality or engender a narcotic habit. When it tones up the strength it does not awaken an insidious appetite for stimulants.

It can deal with a dozen symptoms as well as with one, and obviates complications of medical prescribing; and inasmuch as no disrobing is required the satisfactory therapeutic result obtained by static electricity in the states which accompany the pelvic diseases of women is reinforced by the facility of its administration. It speedily gains a prominent place in the grateful regard of invalids who have enjoyed a veteran's experience with other procedures of gynecology.

Amenorrhœa.—In its simplest form, in girls whose functions have delayed maturing, in chlorosis, spinal and pelvic anæmia, and in general when there are no evidences of a local pathological condition, when examinations and topical methods are undesirable or are refused, and when the encouragement of menstruation is not contra-indicated, the treatment may consist in simply restoring the general state of the health, and when this is done, a few static sparks may be applied to the spine and ovarian regions. When the state of health is prepared for the absent function the stimulation of the spark to the nerve centres and muscular fibres restores it.

tus. The most approved and useful methods of employing these currents in gynecology are fully described in the author's work upon "The Treatment of Disease by Electric Currents." To the local action of the primary methods the general nutritional action of static electricity renders it a most valuable adjunct.

In the interesting cases collected in the second section of this book the necessity of improving the general health before stimulating the function is clearly set forth in the reports of electricians of 1840–50, but in those days they were less able to contribute general nutritional effects with their static machines than we are at the present time. The present dependence upon internal medication is therefore much less, and the static application can accompany the case from the beginning to the end with decided advantage.

Seat the patient upon the static platform and administer positive electrification for about eight minutes. Stop the machine, change the platform connection to the negative pole, and ground both the positive pole and the brass point electrode. Administer a tonic positive spray to the spine and over the lower abdomen for five minutes. In chlorotic, cachectic, and depraved states of health requiring prolonged constitutional upbuilding this treatment may be repeated three times a week for a couple of months, in conjunction with any remedies that may be judiciously prescribed.

As soon as the patient will accept mild sparks to the spine and ovarian region they should be applied at the close of each *séance*. In cases not requiring sustained and regular treatment, and in the latter portion of the care of those who have received sufficient constitutional improvement, the static application may be limited to daily sittings three days before the expected flow.

Before the development of the high-tension induction coil, and the improved galvanic and faradic methods of Apostoli, the static spark was *facile princeps* in the realm of electro-therapeutics as a regulator of the menstrual function. It is as efficient to-day as it ever was, but it has been for the most part superseded by methods which are better in many cases, and yet it may be employed if desired in a large number of cases when only a local stimulation is required and when the exposure of the person for more direct treatment would be refused.

Chlorosis and Anæmia.—Prescribe in the usual manner for these conditions, but when it is practicable to do so, the return of health and normal functions may be expedited by the general and local use of static electricity. These cases are sometimes very nervous and will require gentle management in the beginning.

Seat the patient on the platform positively insulated. At the first few sittings administer positive electrification alone with the negative pole grounded for fifteen minutes. As soon as timidity is allayed, add to this the positive spray for three minutes.

After one or two more treatments nervousness will have been replaced by confidence, and mild sparks around the lumbar and ovarian region may complete each *séance*. Applications should be at least three times a week regularly, and daily for three days before the proper time for menstruation.

When the approaching flow creates neurotic disturbances, headaches, etc., without positive dysmenorrhœa, the static application will relieve them entirely. This is the most suitable form of menstrual stimulation in chlorotic girls, as no delicacy is sacrificed and the patient need not even be aware of the expected action of the sparks.

Static Electricity and Menstruation in General.—When patients are undergoing a course of treatment by static electricity for some chronic affection, perhaps entirely disassociated from any pelvic cause, they may ask if treatment should be stopped during menstruation. Static sparks are usually not well borne at such a time, and practised operators make it a rule to omit them; but as the mild head breeze and simple electrification are not only peculiarly grateful to menstruating women, but afford relief to much of the irritability or even dysmenorrhœa which arises chiefly from ill health, it is beneficial and desirable to continue modified treatment during the period.

As no disrobing or exposure of the patient is required in

static electrification questions, of delicacy do not enter into the consideration of the case.

Cervical and Lumbar Backaches of Women.—If there is in the whole range of medicine an unfailing balm to the woman whose back feels as if it would "break in two" it is the electrical current generated by the Holtz apparatus.

Whether the ache is high up or low down, is mild or severe, is recent or old, is superficial or deep, is sore and tender to touch so that she can hardly wear her clothes, or is of the opposite character, I want no other remedy than electricity in some form.

The first, simplest, and unfailing remedy for recent pains of congestion or fatigue is the static breeze. To older and more obstinate cases add the mild spark or counter-irritation.

There are few women who do not have backaches at some time. There are still fewer women who cannot obtain prompt and efficacious relief from selected forms of electrical applications. If the breeze and spark fail to do well in an inveterate and deep-seated case there is still left among the resources of the static machine the rapidly interrupted high-potential small Leyden-jar current which will handle the remainder of the cases.

Gynecological Wrecks.—Some years ago women encountered a panacea for the cure of their infirmities of whatever sort, from neuralgia to epilepsy. The result has put into our hands an army of women without ovaries, but with a nervous system with an unimpaired capacity for getting sick and feeling miserable. The reflex symptoms of disturbance are often about as great as they had been before the cause (?) was removed.

It is a thankless task, wellnigh beyond the powers of safe remedies, to follow these neurotic symptoms and give satisfactory relief. Drugs which are cruelly deceptive in their palliation of neuroses are too often injurious in ultimate effects to be long continued. Between bipolar faradization and static

electricity relief can be afforded to patients of this kind who would otherwise drift hopelessly along in a pitiful and desponding state.

"Nerves."—Either about the time of an approaching period or when subjected to some social or domestic strain, an otherwise well woman is apt to feel "all nerves, and as if she must fly," while the jaded head of a large family may almost feel desperate enough to "run away and never return."

Seat such a woman in a reclining-chair upon the static platform. Connect it with the positive pole. Ground the negative pole and request her to close her eyes and compose herself for a siesta. Start the machine into a sufficiently rapid action to maintain a vigorous current for fully twenty minutes, and the nervous system will be called away from its distractions and receive a new invoice of strength and rest.

If the patient has been treated before and is accustomed to the method, she will also desire a refreshing spinal breeze. If she is in ordinary health this single administration will suffice for another month or until she gets out of sorts again. If she is worn out with household cares a couple of months' regular and frequent treatment by the same method would cost her husband a great deal less than a trip to Europe and would do her about as much good. Potential alternation is a superb remedy also for these cases.

Puberty.—It is self-evident to any one familiar with the physiological action of static electricity that when either girls or boys are maturing with tedious delay, and especially when they have just suffered from some prostrating acute illness and convalesce slowly, scarcely any other agent would do them an equal amount of good. We need not dwell on this point. It is simply a question of suiting the method to any given patient's needs.

Pregnancy.—Is this state a contra-indication for static electricity, or has this agent a comforting hand to hold out to the physiological invalid who is suffering from gestation?

The facts negative the first part of this question and reply in the affirmative to the second.

In the first three months of pregnancy I regard the sedative tonic effects of static electricity as not contra-indicated in any reasonable form of administration which is necessary for the treatment of other conditions of the patient.

All administrations of static in the form of general electrification, breeze, and spray are safe and beneficial at all times during the entire course of pregnancy, whenever and wherever they are needed. They cause no muscular contraction, and no untoward occurrence that might appear to be coincident could be attributed to them.

Powerful sparks in the region of the pelvis would not be applied during any stage of pregnancy except for good cause by one accustomed to every phase of static electricity, although as a matter of fact I have never seen them do any harm in any case, nor do I believe that it would be possible to produce a miscarriage by rational therapeutic measures with this agent. Sparks may be applied to the rheumatic joints, myalgic muscles, and neuralgic pains with the same good results and absence of harm that they are applied to non-pregnant women.

Static electrification, positive or negative, and the positive breeze and spray, are not only as safe and beneficial as sleep itself when they are indicated in pregnant women, but more than any other sedative-tonic within the range of medicine a skilfully handled static machine will conduct them comfortably through the functional disturbances of gestation.

The head breeze **will** remove for the time any headache that does not demand mechanical support to a dragging uterus for its relief. The mental states are comforted in the same way. The backaches are wholly removed as often as they recur by the spray and mild spark. Nausea often vanishes during general positive electrification and especially after a positive breeze over the region of the solar plexus. General nervous disturb-

ances are controlled in the same manner, and for some time after such a treatment the patient feels like a new being.

I have seen a woman in the third month of pregnancy step upon my static platform in such a state that it would be the despair of a medical prescriber to select a remedy that would enable her to become fairly comfortable without regard to time. In fifteen minutes she has spontaneously declared that she "felt made over new," had lost the nausea, repugnance at the mere thought of eating, severe lumbar pains, numbness in both upper and lower extremities, headache and depression in spirits, creeping chills, and has gone from the office directly to the dinner table and enjoyed a hearty meal.

Such amelioration is not limited to a few moments after the treatment. It sometimes lasts but a day, while in other cases the patient continues to feel comfortable for one or two or more weeks. But after one experience with such an agent, with its demonstrated power to comfort her condition, she never again fails to turn to it for relief when occasion requires.

If frequently administered during the latter part of gestation it will act as an efficient tonic and nutritional stimulant, and aid in meeting the trials of parturition with unshattered nervous forces and unimpaired muscular strength.

In relieving the pains, discomforts, and conditions which interfere with nutrition and sleep in the last month of pregnancy the static machine does for a suffering woman what nothing else can do to tide her over the crisis.

It is well to say also that electrical tonic sedation often so far outclasses the effects of bromides, and other hypnotics, anodynes, and sedatives as to displace entirely their routine use in the practice of the owner of a static machine, to the unspeakable benefit of his patients.

The Menopause.—To one who has never personally witnessed the benefits bestowed upon women during the neurotic disturbances of the menopause the verbal recital of the action of static electricity upon this state would seem like gross ex-

aggeration. It is a "state of disordered function," and every physician should carefully read the physiological action of static electricity upon functional derangements of the system. There will then be no occasion to charge any one with extravagance in reporting his clinical experience.

The general depression of the system caused by an attempt to subdue the neuroses of the menopause by the prolonged administration of bromides is an opprobrium upon scientific medicine, and the attempt to select remedies upon symptomatic indications often keeps both the physician and patient busy.

In many cases, however, the unfortunate woman either thinks that nothing can be done for her relief (and she accordingly endures her condition with what fortitude she can), or else her doctor prescribes a palliative and advises her that time alone will bring her permanent relief.

The fact should certainly be known to every member of the medical profession that this class of cases is distinctly within the chief sphere of action of sedative-tonic and function-regulating static electricity.

It is at this time of life again that mild static sparks around the pelvis have an effectual influence in regulating the declining menstrual function, just as they effectively regulated the commencing activity in puberty.

To recite the other capabilities of the different forms of application would be to narrate in detail every nervous, muscular, and functional disturbance of this period of a woman's life; for static electricity will relieve them all, will direct into normal channels of action the unsettled activities of sympathetic and cerebro-spinal nerves, and conduct the woman through and out of the season of the climacteric in a rational and satisfactory way.

To the operator who understands the management of his apparatus, the Holtz machine dispenses at once with many other agents of the materia medica for the functional derangements

of this stage of life, and not only surpasses them singly but collectively in value.

Standard Current Tests.—The basis of this book is the author's clinical experience. Part of that experience was acquired with a six-plate, twenty-six-inch Holtz machine, and part with an eight-plate, thirty-inch machine. In both cases the therapeutic value of static electricity is the same, for it is not the apparatus but the operator's use of the apparatus which performs the work.

It will be observed that no attempt is made throughout this volume to direct every possible variation in the treatment of each disease. The chief principles of treatment are clearly outlined, and to elaborate and describe a dozen other mechanical manipulations of electrodes would be superfluous. The expert will always develop individuality in the technique of his chief methods.

Owing to the fact that the name of a disease furnishes little idea of the general state of the patient when first seen in the office, it is out of the question to lay down fixed rules. I have made an attempt in the foregoing pages to assist the general practitioner with practical clinical information, but it by no means follows that the methods described are always applicable.

On the contrary, I unhesitatingly set aside everything in the way of rule in the presence of the clinical facts of the patient's actual condition, regardless of the name of any disease whatever.

My therapeutic methods are based upon the treatment of the patient, in accordance with local and general pathological or symptomatic indications. I accept no other guide, and look for results to direct both the regulation of the dose and the frequency and duration of treatment.

It is essential that those who follow my teachings should approximate as nearly as possible the same efficiency in the working capacity of their apparatus which I maintain.

I have frequently observed static machines similar to mine

in other offices working at a reduction of twenty-five, fifty, and even seventy-five per cent of their normal maximum. Owners have not seemed aware of this until it was pointed out. Tests of the matter are simple, and each reader can determine for himself how far his current efficiency differs from the maximum. The current may be wasted in either of three places: inside the case, between the poles, or on the platform.

Test 1. If the machine develops high internal resistance, jumps a spark between a comb and collector when in very rapid motion, with the negative pole grounded and the positive pole connected with the platform, the production of current by the machine and within the case is at its maximum.

Test 2. Short-circuit the sliding poles, start the machine into rapid action, and draw the poles gradually apart. This test should be made in a darkened room. If the convective discharge holds between the balls of the sliding rods until the distance between the poles is within a couple of inches of the radius of the plates, and if, when the luminosity divides, the "fox-tail brush" stands out in well-defined and splendid radiance from the positive pole, with little or no leakage elsewhere, there is no waste worth speaking of at this very important part of the machine.

Every physician should test his apparatus in this manner. If the brush discharge refuses to form the "fox-tail" appearance, or rather an appearance which more resembles the ordinary whisk broom with its short handle, and jumps across an air gap of only four, six, or eight inches, the output of the machine is wasted somewhere else, if the first test shows that current is generated in abundance inside the case. The place can be detected by the eye in a dark room.

Test 3. With the negative pole grounded and the positive pole placed as usual in connection with the platform on which the patient sits, start the machine into rapid action and request the patient to approach the hand near any part of the platform rod.

If before the hand actually touches the rod a spark passes, the length of it will determine the amount of current waste. As the resistance of the air is very great a very short spark will indicate some waste, and a spark only a quarter of an inch long would indicate a great deal of waste, with a corresponding reduction of the therapeutic efficiency of that operator's work, no matter if the machine itself was the most powerful and finest ever made.

When a patient upon the platform connected with my own machine performs this test, there is absolutely no sensation of the slightest spark discharge between the rod and the hand. This shows a complete elimination of resistance in the external path of the current, and supplies within the patient the maximum output of the machine at any rate of revolution desired.

It is essential to make this plain, for all terms of description have relative meanings, and must be interpreted upon a uniform understanding or results will differ. The terms "mild spark" and "strong spark," for instance, may convey to different minds as great a disparity of actual measurement as the terms mountain and hill would convey to the dweller in the Alps and the inhabitant of the prairie. Unfortunately there are no mathematical forms in which to express the dosage of general electrification and localized methods, but under the teachings of experience and careful study it is reasonably certain that all operators can attain sufficient proficiency for valuable therapeutic work with the static machine, if they will keep it in good order.

PART II.

"RECENT IMPROVEMENTS OF THE STATIC ELECTRICAL MACHINE, 1790.

"As soon as the properties of electricity were in some measure developed, the philosopher and the mechanic concurred in contriving and constructing a variety of electrical machines to excite and accumulate this extraordinary agent. The construction of the machines from their first invention to the present time has undergone so many changes, and their forms have been so much varied that it would be very difficult and even tedious to describe those only which have been from time to time adopted in general use. In the earlier part of the eighteenth century every maker and almost every electrician constructed his own machine after his own idea and in a manner different from the rest; and as new facts or long experience pointed out some imperfection, there resulted a gradual improvement in the character and quality of the static machine. In proportion as the science advanced and its boundaries were extended, the greater part of the earlier machines were laid aside and have now become entirely obsolete. We shall therefore only describe the electrical machine which is now in general use, and whose construction is best adapted to produce the electric fluid in great quantities, and transmit it in full and continued streams to the prime conductors, and whose action is nearly constant at all seasons of the year."—*From Hall's "Encyclopædia," London, England, 1790.*

CHAPTER I.

HISTORICAL THERAPEUTICS.

Study of this section indispensable to a correct understanding of static electricity as a remedial agent. The accuracy of early investigations. Physiological and polar actions demonstrated before the discovery of galvanism. John Wesley and the static machine. His experience in the treatment of several thousand cases. Wesley's list of diseased conditions successfully treated in his three dispensaries. Franklin's treatment of a young lady with fits. His unsuccessful methods. Letter from Franklin on the effects of electricity in paralytic cases, 1757. Letter from Franklin describing a Leyden-jar shock given himself.

To the serious student of static electricity this is the most important section of this book.

It must forever possess an unfailing interest, to those who acquire for the first time some familiarity with one of the very greatest of single therapeutic agents, to discover in the investigations of a past age the solidly established basis of clinical confidence in its use.

The men who demonstrated the foundation principles of static current action were exceptionally skilled in the operation of their apparatus. It is rare to-day to find physicians of whom the same can be said. Those who seek to improve their technical skill will derive immense assistance from study of the following pages.

If we substitute the technique of the spark for the now obsolete shocks from Leyden jars we see that the principle of action is the same, and that the sifting of therapeutic methods has about outlived change. It is difficult to foresee that the established and present methods of employing static electricity in medicine will undergo any material alteration while this generation lives. Unless some radical change in the entire system

of treating disease should in future displace the whole structure of our present materia medica, I see no reason to believe that the application of general electrification, breeze, spray and spark, will ever require improvement or substitution. They are as settled as the technique of vaccination.

The great improvement that will take place, and is now hopefully started, is the same as that which is taking place in the *improvement* (?) *of arithmetic!* The rules of arithmetic are established, but in the process of time they are new to every child, and are also forever a mystery to the illiterate. Every physician who for the first time begins the study of static electricity is in the same stage of enlightenment as the child who is learning to add two and two together. To the great mass of physicians who never attempt to overcome their "illiteracy" on this important branch of medicine it remains forever what the multiplication table remains to the child who does not attend school. The ignorance of children about the facts of arithmetic does not impair the usefulness of mathematics to the architect and engineer; nor does the general ignorance of the medical profession about the established facts of static electricity impair the therapeutic properties of this great clinical agent.

It has been the custom in occasional articles upon this subject to review the history of electricity from antiquity to the present time, enumerating each step and describing each frictional machine. These crude beginnings possess an historical interest, but it relates chiefly to mechanics, physics, and philosophy. I consider that the therapeutic history of static electricity is not only much more entertaining and instructive, but is essential to the comprehension of its actual place in medicine. Every physician should study this part of the book with thoroughness and he will be amply repaid by the instruction it will afford.

It has been customary to assume that medical electricity began its career with "quacks." That such was not the case

is proved by the classical reports which follow. Cavallo, Addison, Bird, and Gull were men distinguished by practical sense, high position, sound judgment, and scientific attainments. It is an education in the physiological action of static electricity to read the conclusions which these men formed and stated. Alterations in the view of pathologists about disease certainly affect some part of clinical therapeutics, but the action of mercury, of quinine, of cod-liver oil, iron, opium, strychnine, digitalis, aconite, and other great drugs of the materia medica does not differ with time. Actions of drugs ought to be better understood as medical knowledge progresses, and the action of static electricity within the living tissues ought to be better understood in the future than it is to-day; but as a matter of fact, neither the past ten years, and in some cases not the past fifty years, have made any alteration in the clinical uses of certain drugs, except to prepare them in more elegant forms for administration.

It is important to recognize this stability of the chief clinical uses of our greatest drugs in order to appreciate at its right value the clinical stability of static electricity. It cannot fail to excite wonder and admiration in the mind of the thoughtful student on this subject to discover that neither the lapse of time, nor scientific research, nor laboratory experiments, nor clinical experience, casts any shadow upon the brilliant history of static electricity in medicine. The nature of its action upon the tissues was so well understood when Cavallo wrote in 1781, that but little was added to the known facts when Gull wrote in 1853—and Sir William Gull was one of the foremost medical men of his age. It is needless to say that almost nothing has been added to the established facts of physiological action in our own time. Investigations are reported in somewhat different language but they mean the same thing as before, and it is this remarkable fact which guarantees the stability and permanence of static electricity in its important medical uses.

For one moment let me consider the suggestion that while

this may be true of physiology it is less true of technique, and that changes are continually going on in the methods of applying this agent to the treatment of disease. Those who will read a description of the methods employed in Cavallo's time (and for this purpose the report is included here) may relieve their uncertainty on this point. Nevertheless we may waive the argument that all the chief methods of technique have now been on trial for a century, and coming down to our own times will ask what method is in any respect new in the last decade. The nearest recent approach to any innovation in method within ten years was suggested by the present author in 1893, and if those advocates of the "continual-change" theory cannot point out a single deviation from former methods in the past four years what ground have they to stand on?

I now begin the story which possesses a singular fascination to the student of electro-therapeutics, a story which is not without romance, and is yet as practical and concise as logic.

The immortal name of John Wesley is singularly associated with the history of the early static machine.

This man of remarkable abilities and phenomenal career was born in 1703. He lived eighty-eight years, and his life was a masterpiece of toil and achievement. He was not an "empiric." His intellect was of a high order, and his physical endurance, judged by the mere record of the work he did, was marvellous. As the guiding spirit of Methodism for over fifty years his name is revered throughout the world. But he appears to have been not only one of the greatest preachers of all time, but also one of the soundest and most sagacious lay physicians of his day.

For the benefit of the common people among whom his great missionary work was done he published in 1755 a unique collection of eight hundred and twenty-nine receipts for two hundred and eighty-eight different conditions of disease in a volume entitled "Primitive Physic," which speedily ran through twenty

editions. While this book would do much credit to many modern writers of medicine, its interest for us is centred in what it says about static electricity.

In a preface dated November 10th, 1760, and speaking of new remedies since a previous edition in 1755, he writes:

> In the course of time I have likewise had occasion to collect several other remedies tried either by myself or others. Some of these I have found to be of uncommon virtue, and one I must aver from personal knowledge grounded upon a thousand experiments to be far superior to all the other medicines I have known. I mean electricity. I cannot but entreat all those who are well-wishers of mankind to make full proof of this. Certainly it comes the nearest to an universal medicine of any yet known to the world.

Among the several recommendations for treatment in various diseases, some of which are surprisingly modern and familiar, and are prescribed in very nearly the same way to-day by thousands of practitioners, Wesley makes the following references to electricity:

> Baldness. Electrify daily.
>
> Bruise. Electrify the part. This is the quickest cure of all.
>
> Burn or scald. Electrify it. If this can be done presently it totally cures the most desperate burn (deep burns excluded).
>
> To prevent cramps. Be electrified through the part which is affected.
>
> Dropsy. Be electrified. This cures dropsy supposed incurable.
>
> Clouds flying before the eye. Be electrified.
>
> Earache. Be electrified.
>
> Epilepsy. Be electrified.
>
> Headache. Be electrified.
>
> Lunacy. Be electrified.
>
> Nervous Disorders. I am firmly persuaded there is no remedy in Nature for nervous disorders of every kind comparable to the proper and constant use of the electrical machine.
>
> Old age. Be electrified daily.
>
> Paralysis. Be electrified daily for three months, from the places where the nerves spring which are brought to the paralytic part.
>
> If the parts below the head be affected the fault is in the spinal marrow. If half the body, half the marrow is touched.
>
> Paralysis from working in white lead or verdigris. Be electrified.
>
> Toothache. Be electrified through the teeth.

Ulcer. Be electrified daily.
Menses obstructed. Be electrified.
Tapeworm. Be electrified with sparks and afterward purged.
Drawing sparks removes those tumors on the eyelids called barley-corn, by exciting local inflammation and promoting suppuration.

The foregoing paragraphs are scattered throughout the book, at the close of which he places the following remarkable summary, three-fourths of which is as true to-day as when written a hundred and thirty-seven years ago.

Electrifying in a proper manner cures St. Anthony's fire. Amaurosis. Bruise, bronchocele, burns or scalds. Coldness of the feet. Contraction of the limbs. Convulsions. Cramp. Deafness. Falling sickness. Feet violently disordered. Felons. Fistula. Fits. Flooding. Ganglion. Gout. Headache. Imposthumes. Inflammations. Involuntary motion. King's evil. Knots in the flesh. Lameness. Wasting. Weakness of the legs. Restores bulk and fulness to wasted limbs. Cures locked jaws or joints. Menstrual obstruction. Ophthalmia. Pain in the stomach. Paralysis. Palpitation of heart. Rheumatism. Ringworms. Sciatica. Shingles. Sinews shrunk. Spasms. Stiff joints. Sprains, however old. Surfeit. Swellings of all sorts. Sore throat. Toothache. Twitching of the eyelids. Ulcers. Wens.

At another date he declares concerning electricity: "It is a thousand remedies in one," and adds: "It is absolutely certain that in many, very many cases it never fails," and does not doubt but that more "nervous disorders would be cured in one year by this remedy than the whole English materia medica would cure by the end of the century."

The profound impression made upon this experienced and practical man by the effects of static electricity employed under his own eyes is again apparent in an entry in his private journal in November, 1756.

Having procured an apparatus on purpose, I ordered several persons to be electrified, who were ill of various disorders, some of whom found an immediate, some a gradual cure. From this time I appointed first some hours in every week, and afterward an hour in every day wherein any that desired it might try the virtue of this

surprising medicine. Two or three years after, our patients were so numerous that we were obliged to divide them, so part were electrified in Southwark, part at the foundery, others near St. Paul's, and the rest near Seven Dials; the same method we have taken ever since. And to this day, while hundreds, perhaps thousands, have received unspeakable good, I have not known one man, woman, or child to have received any hurt thereby. So that when I hear any talk of the danger of being electrified, especially if they are medical men who talk so, I cannot but impute it to great want either of sense or honesty.

The name of greatest historical interest to Americans is that of Benjamin Franklin. Influenced by reports that reached him from Italy and Germany, he obtained an electrical machine and personally treated a considerable number of patients. This was in Philadelphia in 1752. The quaint description of her own case by one of his young lady patients is worth quoting.

At length my spirits were quite broke and subdued with so many years affliction, and indeed I was most grown desperate, being left without hope of relief. About this time there was great talk of the wonderful power of electricity; and as a person reduced to the last extremity is glad to catch at anything, I happened to think it might be useful to me. Altho' I could have no encouragement from any experiment in the like case, I resolv'd to try, let the event be what it might; for death was more desirable than life, on the terms I enjoy'd it. Accordingly I went to Philadelphia, the beginning of September, 1752, and apply'd to B. Franklin, who I thought understood it best of any person here. I received four shocks morning and evening; they were what they call 200 strokes of the wheel, which fills an eight gallon bottle, and indeed they were very severe. On receiving the first shock, I felt the fit very strong, but the second very effectually carry'd it off; and thus it was every time I went through the operation; yet the symptoms gradually decreased, 'till at length they entirely left me. I staid in town but two weeks, and when I went home B. Franklin was so good as to supply me with a globe and bottle, to electrify myself every day for three months. The fits were soon carried off, but the cramp continued somewhat longer, tho' it was scarcely troublesome, and very seldom return'd. I now enjoy such a state of health, as I wou'd have given all the world for, this time two years, if it had been in my power, and I have great reason to hope it will continue."

This interesting patient had been tortured with convulsions for ten years.

Franklin's successes in electro-therapeutics were few, and lacking the training of a physician, he employed methods that were foredoomed to failure.

A contemporary writer states:

> Dr. Franklin having electrified several paralytic persons in America observed that they were generally relieved for a few days at the beginning, but that they afterward either did not mend, or relapsed into the state they were before the use of electricity. Here it must be observed that those paralyses were mostly of a long standing, and also the method practised by the doctor was to give strong shocks, which we have already remarked to be rather prejudiced.

The following letter from this distinguished American to John Pringle, afterwards Sir John Pringle, and president of the Royal Society, speaks for itself.

ON THE EFFECTS OF ELECTRICITY IN PARALYTIC CASES.

CRAVEN STREET, December 21st, 1757.

SIR:

In compliance with your request I send you the following account of what I can at present recollect relating to the effects of electricity in paralytic cases which have fallen under my observation.

Some years since, when the newspapers made mention of great cures performed in Italy and Germany generally by means of electricity, a number of paralytics were brought to me from the different parts of Pennsylvania and the neighboring provinces to be electrized, which I did for them at their request.

My method was to place the patient first in a chair on an electric stool and draw a number of large strong sparks from all the parts of the affected limb and side. Then I fully charged two six-gallon glass jars, each of which had about three square feet of surface coated; and I sent the united shock of these through the affected limb or limbs, repeating the stroke continuously three times a day.

The first thing observed was an immediate greater sensible warmth in the lamed limbs that had received the stroke than in the others; and the next morning the patients usually related that they had in the night felt a pricking sensation in the flesh of the paralytic

limbs, and would show a number of small red spots which they supposed were occasioned by those prickings. The limbs too were found more capable of voluntary motion and seemed to receive strength. A man, for instance, who could not the first day lift the lame hand from off his knee, would on the next day raise it four or five inches, the third day higher, and on the fifth day was able, but with a feeble and languid motion, to take off his hat.

These appearances gave great spirits to the patients and made them hope for a perfect cure, but I do not remember that I ever saw any amendment after the fifth day; which the patients perceiving and finding the shocks pretty severe they became discouraged, went home, and in a short time relapsed so that I never saw any advantage from electricity in palsies that was permanent.

Perhaps some permanent advantage might have been obtained if the electric shocks had been accompanied with proper medicine and regimen under the direction of a skilful physician.

It may be, too, that a few great strokes as given in my method may not be so proper as many small ones; since by the account from Scotland of a case in which two hundred shocks from a phial was given daily it seems that a perfect cure has been made. As to any uncommon strength supposed to be in the machine used in that case I imagine it could have no share in the effect produced, since the strength of the shock from charged glass is in proportion to the quantity of the glass coated; so that my shocks from those large jars must have been much greater than any that could be received from a phial held in the hand.

I am, with great respect,

Your most obedient servant,

B. FRANKLIN.

The kind of treatment Franklin had been giving his patients may be appreciated from his account of the effect of one of his shocks upon himself, narrated in a letter to John Ingenhouz, April 20th, 1785.

MY DEAR FRIEND:

. . . I will now give you an account of the second great shock I received. I had a paralytic patient in my chamber whose friends brought him to receive some electric shocks. I made them join hands so as to receive the shock at the same time, and I charged two large jars to give it. By the number of these people I was obliged to quit my usual place of standing and place myself inadvertently under an iron hook which hung from the ceiling down to within about two inches of my head and communicated by a wire

with the outside of the jars. I then attempted to discharge them, and in fact did so, but I did not perceive it although the charge went through me and not through the others that I intended it for. I neither saw the flash, heard the report, nor felt the stroke.

When my senses returned I found myself on the floor. I got up not knowing how that had happened. I then again attempted to discharge the jars, but one of the company told me they were already discharged which at first I could not believe, but on trial found it true.

They told me they had not felt it, but they saw I was knocked down by it which had greatly surprised them. On recollecting myself and examining my situation I found my case clear. A small swelling rose on the top of my head which continued sore for some days, but I do not remember any other effects good or bad.

The stroke you received and its consequences are much more curious. I communicated that part of your letter to an operator encouraged by Government here to electrify epileptic and other poor patients, and advised his trying the practice on mad people according to your opinion.

B. FRANKLIN.

CHAPTER II.

GENERAL REMARKS RELATING TO MEDICAL ELECTRICITY, BY T. CAVALLO, F.R.S., 1777.

Accounts of the great interest everywhere manifested in this agent. Study of reported effects. Conservative estimate of its value after forty years of clinical experience. Skill in operation of apparatus necessary to successful treatment. Why electricity often cures obstinate diseases which have not yielded to other treatment. General rules for practice. Regulation of the dose. Therapeutic effects of static electricity upon functional and nervous diseases. Hints for the administration of the static breeze and sparks in 1777. The electrification of children. The relative efficiency of large and small machines judiously discussed. The largest static machine ever made (1790). Rules for ascertaining the correct dose in static treatment.

Soon after the discovery of the electrical machine the wonderful effects of that unknown cause generally named electricity were applied as a remedy for various disorders of the human body.

The first hints of this application seemed to have been suggested by observing the effects produced upon persons electrified from curiosity, who, being generally afraid of this extraordinary power, attributed entirely to it all those effects which might in a great measure have been produced by fear and apprehension such as increased perspiration, heat, increase of pulsation, etc.

The number of persons who were electrified at that time is prodigious, and the pretended cures effected by it were wonderful indeed. Accounts of the miracles performed by electricity were published in various parts of Europe together with the methods of electrifying the patient; to which were added such theories as, even allowing for the infancy of electricity at the time, would seem impossible ever to have been proposed to the

public. Those theories were usually enforced by the account of experiments which often proved false upon examination. The medicated cylinders for electrical machines are a remarkable instance of this kind.

But at present a much better acquaintance with the science of electricity than philosophers had about thirty or forty years ago, and less faith in the reports of the generality of those persons whose interest it is to promote the use of electricity in medicine, have pointed out the effects of this agent upon the human body under various circumstances, and have shown how far we may confide in it; establishing upon indisputable facts that electricity is neither the panacea it was considered by some fanatical and interested persons to be, nor so useless in application as others had asserted, but that when properly managed it is a harmless remedy which sometimes instantaneously removes divers complaints, generally relieves and often perfectly cures various disorders, some of which could not be removed by the utmost endeavors of physicians and surgeons.

When the first rumor occasioned in Europe by the accounts of both pretended and real wonders performed by electricity had in some measure subsided, many creditable and experienced physicians who, justly considering it as their duty, had undertaken to examine the power of this new remedy, published some unsuccessful applications of electricity in divers diseases, in which cases they had not only prescribed the electrization but had performed the operation themselves or had it done under their own inspection. These publications gave a new turn to the reputation of medical electricity and since that time the generality of physicians and surgeons had not the least regard for its medical application, so that the practitioners of it were rather considered as fanatics and impostors.

However, an attentive examination of this subject after several trials, and after overcoming in a great measure the rooted prejudices among physicians, began to establish anew the repu-

tation of medical electricity, and showed that many of the applications of electricity published in the above-mentioned accounts had been unsuccessful *because the operation was not managed properly; so that it had been the abuse, and not the use of electricity that had proved unsuccessful or detrimental,* for at that time strong shocks and strong sparks were generally administered which a long series of experiments and observations had proved to be generally useless or hurtful.

Mr. Lovett, who practised medical electricity for a long time, was, so far as I know, the first to protest against the use of strong sparks, and in an essay of his, entitled "Subtil Medium Proved," asserts that the shocks to be used in medical electricity should be very small; by which treatment he hardly ever failed of curing or at least relieving his patients.

Electricity, different from other physical applications, requires rather a nicety of operation than a thorough knowledge of disease.

That it is possible to apply electricity properly without a just knowledge of the disorder may seem a paradox; but it will be presently shown that to electrify a sound part of the body together with the diseased one is by no means prejudicial, and that the degree of electrization must be regulated rather by the feeling of the patient than by the species of disorder.

From whence it must follow that the application of electricity may be properly managed even with a superficial knowledge of disease; but it must be confessed that further experience may possibly show much easier and more certain ways of applying it differently for different diseases, and therefore it is more likely that medical electricity will receive more improvements in the hands of skilful physicians and surgeons than when managed by persons whose whole success is largely a matter of chance.

The superiority of electricity over other remedies in many cases may appear from considering that medicines in general cannot always be confined to a particular part of the body, and

to let them pass through other parts is often dangerous, for which reason they cannot be used.

Besides, after some medicines have exerted their required power they are with great difficulty separated from the body; but it is of no consequence whether the power of electricity passes through this or that other part of the body in order to reach the seat of disease, for after having exerted this action it is instantly dispersed.

Hence it appears why electricity has often cured such obstinate disorders as have not yielded to other treatment.

General Rules for Practice, by Cavallo, 1781.—It should be attentively observed to employ the smallest force of electricity that is sufficient to remove or to alleviate any disorder.

Shocks should never be used when the cure may be effected by sparks; sparks should be avoided when the required effect can be obtained by the breeze, and even this last may be omitted when simple electrification may be thought sufficient.

The difficulty consists in distinguishing the proper strength of electric power that is required for a given disorder, the sex and constitution of the patient being considered.

In regard to this point it is impossible to give any exact and invariable rules, the circumstances being of such a nature and so various that long experience and a strict attention to every particular phenomenon are the only means by which proper instructions may be received.

The surest rule, as we have observed above, that can be given relating to this particular is to begin with the most gentle treatment; at least such that, considering the condition of the patient, may be thought rather weak than strong. When this gentle treatment is ineffective the operator may gradually increase the force of electricity till he finds the proper degree of it.

In judging of cases proper to be electrified experience shows that in general all kinds of obstructions, whether of motion,

circulation, or secretion, are very often removed or alleviated by electricity.

The same may also be said of nervous disorders.

In cases of gathering tumors the best method is to draw the fluid by means of a wooden point, or, if that proves painful, by a metal point. Sparks in these cases, and also shocks, are often hurtful.

In stiffness, paralysis, and rheumatism small sparks, especially through a double flannel and also very small shocks—say a sixteenth of an inch—may be used. Stronger shocks may sometimes, though seldom, be administered for a violent toothache and for some internal spasm of no long standing.

When any limb of the body is deprived of motion it must be observed that the deprivation of motion is not always occasioned by a contraction of the muscles, but that it is often the effect of relaxation. Thus, for instance, if the hand is bent inward and the patient has no power to straighten it, the cause may be a weakening of the outward muscles as well as a contraction of the flexors. In such cases, as it is often difficult even for good anatomists to discover the real cause, the surest method is to electrify not only those muscles which are supposed to be contracted but also their antagonists, for to electrify a sound muscle is by no means hurtful.

When the breeze is administered the length of the application should be from three to ten minutes, more or less as occasion may require.

When shocks are given, their greatest number should not exceed a dozen or fourteen.

The number of sparks, when they are used, may generally exceed the number of shocks mentioned above.

Lastly, it may be of use to mention that when children are electrified upon the insulating chair, and it is difficult to get them to remain quiet, the most convenient way is to let another person sit in the chair and hold the child while the operator is treating it.

[illegible]

[illegible] The [illegible] faster or [illegible]

It is impossible to prescribe the exact degree of electrization

* In another part of a later edition of his work a machine with two plate-glass discs 6 feet in diameter from which twenty-four-inch sparks can be obtained and with which he performed many astonishing experiments. It is made about 1760 for the museum of Teyler at Harlem, and operated by Mr. [illegible]. A prime conductor attracted a thread from the perpendicular at a distance of thirty-eight feet.

† We employ exactly the same methods to-day (1897).

that must be used for various disorders, for persons of different constitutions, although afflicted with the same disease, require different treatment. Some persons are of so delicate and irritable a constitution that the smallest sparks give as much pain as shocks do others. In respect to this important point, therefore, the operator must certainly be instructed by experience. However, in the beginning he may be assisted by the two following rules:

1st. He should begin to administer to his patients the very smallest degree of electric power, which he ought to continue for a few days so as to observe whether it produces any good effect, which, if it fails to do, he should then increase the strength of the electricity, and so proceed gradually till he finds the effectual method which he should follow till his patient is cured. A little practice will enable him to determine at once what degree of strength is required without any useless attempts.

2d. The degree of electrization should never exceed what the patient can conveniently endure, as experience shows that when the application of any degree of electricity is disagreeable to the patients they very seldom mend.

CHAPTER III.

CLINICAL CASES TREATED BY STATIC ELECTRICITY.*

Inflammation in both eyes treated with the static breeze. Erysipelas treated with the static breeze and mild spark. Lachrymal fistula treated with very mild sparks. "Violent sore throat" relieved by two applications of mild sparks to the throat. Amenorrhœa lasting seven months relieved by sparks through the pelvis. Ulcers of the lower extremities healed by static applications. Static sparks regarded as a specific for arrested menstruation. Letter reporting a cure of muscular contraction by static sparks (1777). Chorea in a young girl successfully treated in July, 1778. Static electricity regarded as a valuable antispasmodic. A case of paralysis treated with bad success by too strong shocks. Muscular rigidity relieved by static electricity.

CASE I.—The particulars of the following case were communicated to me by Mr. Partington.

Daniel Wyscoye, aged 36, of a strong robust constitution, was sent from the Westminster dispensary to Mr. Partington to be electrified for a violent inflammation in both eyes. The account he gave of his disorder was as follows: Several dark objects of different shapes and sizes seemed at first to obstruct his sight. This was succeeded by an inflammation in both his eyes, which increased with such rapidity that in a week's time he was brought to the degree of blindness that afflicted him till he was electrified. He was immediately recommended to the Westminster Dispensary, where every possible attention was paid to his misfortune by Mr. Ford, the surgeon of that place, but the obstinacy of the disorder was such that every endeavor toward the relief of this poor man proved useless.

Blisters and leeches, besides the other usual means, were applied without efficacy.

About two months after the commencement of the inflamma-

* From the treatise of T. Cavallo, F.R.S., vol. ii., 1776–77 and 1795.

tion he was sent to be electrified by Mr. Partington, who on examining him found that the eyelids could not be opened without the help of the fingers, and that when opened, the coats of the eye appeared to be uniform in color. The sight of the right eye which was most affected, was so far impaired that when it was turned toward the window, the eyelids being forced open, he could perceive only a red glare of light like a ball of fire, while the rest of the room seemed to be equally dark so that he could not distinguish an object in it. With the left eye he could distinguish colors and the shapes of objects held before him, but in their sizes he was commonly mistaken.

This disorder was accompanied by excruciating pains shifting from one part to the other, but principally attacking his temples and sometimes darting to the back part of the head or to the centre of his eyes.

Mr. Partington began to electrify him on October 21st, 1776, and three days afterward the inflammation began visibly to abate, and in a fortnight's time was quite subsided, but the pupil of the eye was so nearly closed that scarce any of it could be seen. He continued to be electrified every day for five weeks, and the pupil gradually dilated till he could distinguish objects on the other side of the way. The pain had now entirely left him so that he omitted the use of electricity and did not experience any further inconvenience after it.

This remarkable cure was effected by throwing the stream of electric fluid with a metal and with a wooden point.

The first instrument used which was contrived by Mr. Ferguson consisted of a pointed brass wire fastened by means of a cork at the smaller end of a conical glass open at both ends; and passing though the axis of this funnel-like glass its point came to within about half an inch of the larger aperture of the glass.*

* This ingenious electrode contrived one hundred and twenty years ago very exactly suggests the insulated spark directors now found in the catalogues of dealers and is but another evidence of the established permanency of static operative methods.

This instrument, being designed to throw the electric breeze upon the eye, was to be fixed so that the larger aperture of the glass surrounding the eye kept the lid open, and the point of the wire was opposite the pupil about a half an inch or an inch from it. With this instrument a spark often proceeded from the point of the wire and caused the patient insufferable pain, for which reason Mr. Partington, who spares no pains to advance this branch of physics, thought of improving the instrument by fixing a wooden point upon the pointed wire, by means of which the former inconvenience was entirely removed and the stream of electric fluid was rendered more efficacious and more easily manageable.

This, as far as I am informed, was the first time that this most excellent method of throwing the electric fluid, viz., with a wooden point, was used.

CASE II.—The following case is related by Mr. Lovett in his "Electricity Rendered Useful."

Having observed the great efficacy of the electrical breeze in soon relieving most kinds of inflammations, I was inclined to think the same salutary effects would appear when applied to St. Anthony's fire, but when a case of that sort offered the inflammation was so great that at first sight I almost despaired of success.

About the middle of the day I made the first trial, and before night the swelling was much abated, and in a few days quite cured. The operation was simply drawing sparks with a finger, or an iron style, while the person was electrified on the insulating stool.

CASE III.—The following case is also related by Mr. Lovett:

Ann Thompson, of Worcester, was troubled with a fistula near the inner corner of the eye, which broke out and healed no less than seven times.

The last time it healed it continued well for some time, after which it began with a small swelling and continued growing larger till it was as big as a filbert, when she was advised to

try electricity. After the swelling was electrified it soon decreased till it was entirely dispersed, and has continued well for more than two years, without the least symptom of any return of the disorder.

The operation was simply drawing sparks from the part affected.

CASE IV.—Sore throat. The late Mr. Ferguson being at Bristol was seized with a violent sore throat so that he could not swallow anything. Being willing to try the power of electricity, Mr. Adlam of that city performed the operation, which was merely drawing sparks from the throat. The electrization was repeated half an hour later and was attended with so good and remarkable an effect that in half an hour's time Mr. Ferguson could both eat and drink without pain.

CASE V.—The following two cases are related by Mr. John Birch, surgeon:

A young woman, aged 22, desired advice for a tumor on her thigh which resulted from an accident two years previously.

Her case presented many complications, among them suppression of the menses which had lasted seven months. I thought it right to relieve if possible this symptom before operating on the tumor. For three successive days I passed some electric shocks through the region of the pelvis, and on the fourth she was attacked with a violent pain in her side which left her on applying the shocks to that part.

In about three hours it returned and I was sent for. I repeated the shocks and the pain again vanished. I visited her six hours after when the pain had begun to attack her side and passed a strong shock, which removed it and she slept well the whole night.

The next day, being the fifth of treatment, the menses appeared and flowed gently for three days; but ceasing then, the pain in the side returned and I was sent for in a hurry. When I came to her I found her in great agony, but being informed of the cause I begged to make trial of electricity once more,

which she readily consented to as she had experienced such instantaneous relief before.

On its application the pain ceased. A very short time after the flow came on and continued two days. I attended her for several weeks after and had the pleasure to see her recover from all her complaints.

CASE VI.—I was sent for by a lady who had been afflicted with painful ulcers on both legs for more than fifteen months. They appeared after her confinement and had never healed. The legs were swelled but the ulcers had no malignant appearance. She told me that since her last miscarriage, ten months previously, she had never been regular. She attributed the pain and swelling of her legs to that cause, and upon inquiry I found that she was sensible of an endeavor of nature to relieve herself at regular periods, and that the pain she suffered at those times were alleviated by a bloody discharge from the ulcers. I applied dressings and bandages to the parts and started the menstrual period. In about ten days a pain seized her back and she began to complain of her legs. I then electrified her, and the next day she was taken unwell and continued so the whole week. The ulcers mended from that time and were healed three weeks later.

The reader may rest assured that cases of this kind are so frequent that perhaps electricity may be considered as a sure remedy for the arrest of those natural fluxes.

The following case is extracted from the sixty-eighth volume of the "Physiological Transactions."

"A Cure of Muscular Contraction by Electricity," by Mr. Miles Partington in a letter to William Henly, F.R.S.

CHARLES STREET, CAVENDISH SQUARE,
June 13th, 1777.

DEAR SIR:—

It is some time since you informed me that you had mentioned to Sir John Pringle Miss Lingfield's cure by electricity; that it excited his attention; and was his opinion that the communication of it to the Royal Society would be deemed important and useful.

I hope you will not blame my delay in complying with your request, for I have waited for no other purpose than to obtain the latest account of the permanency of those good effects which she had then but recently experienced from our electrical experiments upon her.

Of these advantages we have both had repeated confirmation and I may now I believe with strict propriety, from the notes I made for my own satisfaction, submit the following particulars to the inspection of whomsoever your judgment shall direct, or to any other purpose you please.

As you were present when I first waited on the unhappy young lady you will recall the condition in which we found her.

Her head was drawn down over her right shoulder, the back part of it was twisted so far around that her face turned obliquely toward the opposite side, by which deformity she was disabled to see her feet, or the steps as she came downstairs.

The sterno-mastoid muscle was rigidly contracted. She had no material pain on this side of her neck, but owing to the extreme tension of the tissues of the left side she had a pain continually and often it was very violent, particularly in sudden change of the weather. Her pulse was weak, quick, and irregular. She was sub ject to great irritability; had frequently a little fever which came on in the evening; her spirits were generally oppressed and she was at times slightly paralytic.

She dated the origin of her trouble over two years previously, when she was suddenly seized on going out of a warm room into cold air, with a pain in the back of her head which admitted of small abatement for some months, gradually contracting the muscles to the melancholy deformity we then beheld; and notwithstanding the use of very prudent means to subdue it, grew slightly worse.

I urged her to make a trial of electricity, and she was willing while she was in London to try the experiment, and though the weather was remarkably tempestuous she came to me the first tolerable day and was electrified first, February 18th, 1777. I placed her in an insulated chair and, connecting it by a chain to the prime conductor of a large electrical machine, I drew strong sparks from the parts affected for about four minutes, which brought on a very profuse perspiration (a circumstance she had been unaccustomed to) which seemed to relax the mastoid muscle to a considerable degree, but as the sparks gave her a good deal of pain I ceased using them and subjected her a few minutes longer to the static breeze.

She came next to see me on the 24th of February. As she had been in the afternoon after the first treatment a good deal distressed, I changed the mode of application to milder sparks, which she bore

better than before; and the same good effect followed in a greater degree without any of the subsequent inconveniences.

I saw her the third time on the 27th. She assured me she had escaped her feverish symptoms of an evening and that her spirits were raised by the prospects of getting well.

Since the last time I electrified her she had more freedom in the motion of her head than she had ever experienced since the outset of her trouble. I persisted in electrifying her in the same way March 3d, 5th, 6th, 7th and 9th. From each treatment she gained more advantage and her feverish tendency and nervous irritability went off entirely.

The weather now getting very unfavorable, and fearful of losing the advantage of our early efforts, I requested the favor of you, as the next-door neighbor, to electrify her every evening whilst she was in town. Fortunately for her you accepted the proposal and to your judgment and caution in the conduct of it for the next fortnight (three evenings only excepted) you brought about the happy event, and have received her testimony of gratitude for relieving her from a condition under which life could not be desirable, to a comfortable association with her family and friends.

To this letter Mr. Henly adds:

The method I pursued was to place the lady upon a stool with glass legs and to draw strong sparks for at least ten minutes from the muscles on both sides of the neck.

Besides this I generally gave her two shocks from a bottle containing fifteen square inches of coated surface fully charged, through her neck in different directions. This treatment she submitted to with a proper resolution, and it gave me great pleasure to find it attended with the desired success.

CASE VIII.—The following case is taken from the sixty-ninth volume of the Physiological Transactions.

An account of a cure of St. Vitus' dance by electricity, in a letter from Anthony Fothergill, M.D., F.R.S., at Northampton, to Mr. Henly:

NORTHAMPTON, October 28th, 1778.

SIR:—

Agreeable to my promise I now propose to give you some account of a recent cure performed by electricity, which will, I think, afford you much pleasure.

Ann A——, a girl 10 years of age, of a pale emaciated habit, was

admitted as an outpatient at the Northampton Hospital on the 6th day of June last. She was speechless, and was with difficulty supported from falling by two assistants, but from her father's account she had for five weeks labored under violent convulsive motions which affected the whole frame, from which she had very short intermissions except during sleep.

The disease had not only impaired her memory and intellectual faculties, but of late had deprived her of the use of speech. Volatile and medical remedies were now recommended, and the warm bath every other night, but with no better success, except that the nights, which had been restless, became somewhat more composed.

Blisters and antispasmodics were directed and continued till the beginning of July without the least abatement of the symptoms. Her father then growing impatient of fruitless attendance at the hospital, I recommended, as a *dernier ressort*, a trial of electricity under the management of the Rev. Mr. Underwood, an ingenious electrician.

After this I heard no more of her till the 1st of August, when her father came to inform me that his daughter was well, and desired she might have her discharge. To which, after expressing my doubts of the cure, I consented, but should not have been perfectly convinced of it had I not afterward received a full confirmation of it from Mr. Underwood dated September 16th, an extract from whose letter I will now give you in his own words:

"I have long expected the pleasure of seeing you, that I might inform you how I proceeded in the cure of the poor girl.

"As the case was particular I have been very minute, and wish you may find something in it that may be useful to others. If you think it proper I beg you will state the case medically and make it as public as you please.

"July 5th: I sat her on the glass-footed stool for thirty minutes. Sparks were drawn from the arms, neck, and head, which caused a considerable perspiration and a rash appeared on the forehead. She then received shocks* through her hands, arms, breasts, and back, and from this time her symptoms abated, her arms beginning to recover their uses.

"July 13th: On the glass-footed stool forty-five minutes; received strong shocks through her legs and feet, which from that time began to recover their wonted uses. Also four strong shocks through the jaws, after which her speech returned.

"July 23d: On the glass-footed stool one hour. Sparks were drawn from her arms, legs, head, and breast, which for the first time she very sensibly felt. Also two shocks through the spine. She could

* The coated bottle held near a quart.

now walk alone. Her countenance became more florid and all her faculties seemed wonderfully strengthened. From this time she continued mending to a state of perfect health. Every time she was electrified positively her pulse quickened to a great degree, and an eruption like the itch appeared in all her joints."

Thus far Mr. Underwood. To complete the history of this singular case I this day (October 28th) rode several miles on my return from the country to visit her, and had the satisfaction to find her in good health and the above account verified in every particular, with this addition to the history, that at the beginning of the disease she had but slight twitchings, attended with running, staggering, and a variety of involunary gesticulations which distinguish the St. Vitus' dance, and that these symptoms were afterward succeeded by convulsions which rendered it difficult for two assistants to keep her in bed, and which soon deprived her of speech and the use of her hands.

The eruptions which had appeared in the parts electrified soon receded without causing any return of the symptoms, and therefore could not be called critical, but merely the effect of the electrical stimulus.

Having given her parents some general directions as to her regimen, etc., I took my leave with a strong injunction to make me acquainted in case she should happen to relapse.

Before I conclude, it may not be improper to observe, that some time ago I was fortunate to cure a boy who had long had St. Vitus' dance (though in a much less degree) by electricity.

A violent convulsive disease somewhat similar to the above, though, if I recollect right, not attended with aphonia, was successfully treated in the same way by Dr. Watson, and is recorded in the Physiological Transactions.

May we not conclude that these facts alone—and more might perhaps be produced—are sufficient to entitle electricity to a distinguished place in the class of anti-spasmodics?

I am, etc.,

ANTHONY FOTHERGILL, M.D.

CASE IX.—The following is one of those cases in which the use of electricity was attended with bad success. This case was related by Dr. Hart of Shrewsbury. See the Physiological Transactions, Vol. XLVIII.

A girl aged 15, whose right arm was paralytic, being electrified the second time, became entirely paralytic, and remained in that state about a fortnight, when the superadded paralysis

was removed by the means of some medicines. But the arm which was before paralytic remained so.

It should also be added that this arm was very much wasted in comparison with the other. Notwithstanding the first bad accident it was resolved to make another trial of electricity. But after using this treatment for three or four days she became universally paralytic, and even lost her voice and could swallow with difficulty. This second accident plainly showed the bad effects of electricity in that case, and the girl, although afterward relieved of her additional palsy, remained in the same state she was before treatment.

In this case it is suspected that electricity was improperly managed at the time, it being usual to give strong shocks which perhaps were pernicious in the above-mentioned case.

CASE X.—The following case was performed under the direction of the late Sir Wm. Watson, F.R.S.:

A girl belonging to the Foundling Hospital, aged about seven years, being seized with a disorder occasioned by worms, was at last, by a universal rigidity of the muscles, reduced to such a state that her body seemed rather dead than alive. After other medicines had been ineffectually administered for about one month, she was at last electrified intermittedly for about two months when she was so far recovered that she could without pain exercise every muscle of the body, and perform every action as well as before she had the distemper.

The intelligent reader must have undoubtedly remarked that in some of the above cases the electrization administered was rather strong and different from the general rules given previous to the narration of the cases. But it must be observed that some of the cases happened before the principal methods of electrifying which are now used by the best practitioners were introduced.

Perhaps in similar cases the same salutary benefits might be produced by a more gentle treatment.

CHAPTER IV.

SUNDRY CLINICAL OBSERVATIONS.

Letter reporting a cure of fistula lachrymalis. Method of treatment. The effects of electricity upon constipation. Static electricity at Bombay, India, in 1784. A case of paralysis reported by Dr. Lind.

A LETTER FROM MR. MILES PARTINGTON TO MR. CAVALLO.

CAVENDISH SQUARE, August 10th, 1781.

SIR:—

As the possibility of a cure of fistula lachrymalis by static electricity has been publicly questioned, I am glad to comply with your request in stating the successful treatment of a case under my own inspection.

Ann Woodward, between 20 and 30 years of age, was sent to me by Mrs. Swift of King Street, Bloomsbury, in whose service she then lived. I was told she had a fistula lachrymalis which had resisted every attempt to relieve her. I shall describe the situation she was in when I first saw her, and shall add her own account anterior to that time.

There was a very violent inflammation in the left eye attended with excessive pain and almost continual flow of tears down the cheek, the sharpness of which had considerably excoriated the skin. A little prominence was perceivable on the inner angle of the eye, from which might be generally pressed a small quantity of matter.

The inflammation had been kept up with little abatement for six months, during which a cooling regimen had been strictly complied with. Since the inflammation became violent she had constantly awoke in pain which lasted till noon, and was then tolerably easy the rest of the day. She told me that as long as she remembered she had been subject to a weak and watery eye, but it had never given her much concern till she received a cold in it on coming to London. In every other respect she was remarkably healthy.

My first object was to relieve her of the pain. For this purpose I conveyed the electric breeze from a wooden point which generally at the same time blunted the acuteness of the sensation, but which, if the breeze was concentrated by bringing the point near to her

eye, always increased it to a great degree, though this always went off by being left to itself, or by repeating the milder method.

I continued this treatment for three weeks, when the inflammation was nearly subsided and the pain entirely gone away. Still perceiving the matter ooze from the inner angle I continued to pass a single electric shock down the duct of the nose, which I effected by placing one of the directors upon the lachrymal sac and the other up the nostril. This gave her much pain after the operation and it remained all the rest of the day. I found in the morning that she could hardly bear me to press upon the sac, and very little matter came from it.

I then passed four mild shocks in the smallest degree I could convey them to be felt, which were not attended with so much pain. At bedtime there came on a great throbbing in the part, in the course of which a large quantity of matter burst down the nostril, when she became immediately easy. Some matter continued to come away for about four days and she appeared to be perfectly well. Her eye has since been in a stronger state than it ever was before. I can give you further instances of the relief in this disease by electricity, though they have not been so effectually cured.

In the course of my practice I have observed a very remarkable effect of electricity upon the human body, which is that it removes costiveness in those persons that are electrified especially along the course of the alimentary canal. I must observe that it does by no means increase the evacuations of ordinary good habits of the body, but only reinstates the usual discharge in case of costiveness. This effect seems to take place because the electrization gives vigor and energy to the fibres of the debilitated intestines in the same manner as it restores the motion of more external muscles.

I am, dear sir, yours, etc.,

MILES PARTINGTON, M.D.

A LETTER FROM DR. JAMES LIND TO MR. CAVALLO.

WINDSOR, June 17th, 1784.

DEAR SIR:—

I here send you the account of a remarkable case relieved by electricity whilst I was at Bombay. If you think it worth publishing I beg you will insert it in the next edition of your "*Medical Electricity*."

The wife of an officer of the artillery at Bombay during the last months of her pregnancy gradually lost the use of her lower limbs, as if it had been a paralysis due to the pressure of the fœtus upon the nerves which go to the extremities. Her pregnant state did not

allow the application of any remedy for her relief. She went to her full term, was safely delivered, and though she soon recovered in every other respect, yet, contrary to every expectation, the paralysis still remained, nor could it be in the least relieved by any of the various medicines which were administered for about seven months, the time which has elapsed from her delivery until I first visited her in June, 1780.

Finding upon inquiry that, of the many medicines likely to afford relief in such a case, electricity alone had not yet been tried, I immediately recommended the application of it.

But the difficulty was to excite an electrical machine in an atmosphere so exceedingly moist as that of Bombay was at that time, the rainy season being already set in.

However, the husband of the patient, being the superintendent of the Military Laboratory of Bombay, proposed to try whether an electrical machine could not be made to act in a heated room, such as they used for drying gunpowder.

Accordingly, a small stuccoed room in his house was heated by means of burning charcoal; then the doors and windows were thrown open, and an electrical machine being brought in was found to act very powerfully.

Things being thus prepared, my patient began to be electrified, first by giving sparks to her legs and thighs, and afterwards by passing about twenty very small shocks up one leg and down the other. The effect was really surprising, for after the first electrization she was so far relieved as to be able to walk some steps without any help, which she had not been able to do for many months before. By the second day's electrization, which was performed exactly like the preceding, she was enabled to walk out and visit several of her friends in the neighborhood. The third day's electrization completed the cure, and she went about with all the ease and alacrity in the world. I afterwards received a letter from her husband dated May 29, 1781, informing me of her continued perfect health.

Faithfully yours,

JAMES LIND, M.D.

CHAPTER V.

THE PAST AND PRESENT NATURE OF ELECTRICITY THE SAME.

Report upon static electricity in 1790. Mild methods of treatment preferred. List of diseases treated by static electricity, with discriminating remarks upon methods and clinical results.

INFINITELY more interest attaches to this early history of electricity in medicine than to any historical account of medical therapeutics, for the advancement that has been made in all that pertains to the diagnosis and pathology of disease and the scientific preparation, administration, and dosage of drugs deprives the methods of the past of much present definite value.

The cognate facts relating to static electricity are of a different order. Electricity it is still the same potential element that was employed by the masters of the eighteenth century, and it has undergone no change in its attributes or essential character. It is still produced by the same great Alchemist, in the same marvellous laboratory of nature, and has undergone no alteration since it wrought the miracles on Sinai.

"Arts and sciences, like kingdoms and nations, have each in their turn some happy period of glory and splendor in which they more than ever attract the human attention and become the favorite object and pursuit of the age; but these periods are soon over in many cases and a few years of lustre and fame are counterbalanced by centuries of oblivion." The science of electricity has not been exempt from the vicissitudes of similar fortune. After the golden age which lasted out the close of the eighteenth century, it became nearly as much discredited in medicine as if it had never engaged the attention and enjoyed the confidence of the most distinguished physicians. At the

present day it is so generally regarded in the light of a new development in its application to scientific therapeutics that a more than ordinary interest attaches to the following account which I have taken from an old English work of 1790.

Report upon Static Electricity in 1790.—"The account of a few successful cases in medical electricity, as well as in other branches of practice, does by no means establish the reputation of the treatment when a vast number of unsuccessful trials are concealed from the eyes of the public. The variety of temperaments observable in the human species and the coincidence of circumstances is such that sometimes very obstinate disorders appear to be cured by very trifling applications. Physicians, however, justly neglect those kinds of treatment because they have failed in a great many cases, apparently of the same nature.

"In order, therefore, to give a proper estimate of the value of a remedy it is necessary to show the proportion between its successes and its failures without being amazed at one case and neglecting many others.

"Agreeable to this observation the reader will find in the following pages an estimate of the effects of static electricity applied as a remedy for various disorders. This estimate has been deduced from the cases which have hitherto come to my notice, and is therefore likely to receive much alteration and amendment by better information and observation in the future.

"The application of this subtle fluid to medicinal purposes was thought of soon after the discovery of the Leyden jar in 1745–46, and after various turns of reputation its medical virtues seem now to be pretty well established. After giving so particular a description of electrical apparatus under the proper system it would be here superfluous to say anything further on that head. We shall only observe that Mr. Cavallo, of London, who has published the latest and best treatise on medical electricity, entirely disapproves of giving violent shocks, and finds

it more efficacious to expose the patient to the electrical aura discharged from an iron or wooden point; or if shocks are given, they should be very light, and not exceed twelve or fourteen at a time. In this way he recommends it as effectual in a great number of disorders. The patient may be electrified from three to ten minutes; but if sparks are drawn, they should not exceed the number of shocks above mentioned.

"**Rheumatic disorders,** even of long standing, are relieved and generally quite cured, by only drawing the electric fluid, with a wooden point from the part, or by drawing sparks through flannel.* The operation should be continued for about four or five minutes, repeating it once or twice every day.

"**Deafness,** except when it is occasioned by obliteration or other improper configuration of the parts, is either entirely or partly cured by drawing the spark from the ear with the glass tube director, or by drawing the fluid with a wooden point. Sometimes it is not improper to send exceedingly small shocks (for instance, of one-thirtieth of an inch) from one ear to the other. It has been constantly observed that whenever the ear is electrified the discharge of the wax is considerably promoted.

"**The Toothache,** occasioned by cold, rheumatism, or inflammation, is generally removed by drawing the electric fluid with a point immediately from the part, and also externally from the face. But when the body of the tooth is affected, electrification is of no use, for it seldom or never relieves the disorder, and sometimes increases the pain to a prodigious degree.

"**Swellings,** in general, which do not contain any matter, are generally cured by drawing the electric fluid with a wooden point. The operation should be continued for three or four minutes every day. It is very remarkable that in some cases of white swellings quite cured by electricity, the bones and cartilages were in some measure disfigured.

"**Inflammations** of every sort are generally relieved by a very general electrization.

* This corresponds to what are called short "frictional" sparks to-day.

"**In inflammation of the eyes** the throwing of the electric fluid by means of a wooden point is constantly attended with great benefit; the pain being quickly abated, and the inflammation being generally dissipated in a few days. In these cases the eye of the patient must be kept open; and care should be taken not to bring the wooden point very near it, for fear of causing any sparks. Sometimes it is sufficient to throw the fluid with a metal point; for in these cases too great an irritation should always be avoided.

"It is not necessary to continue this operation for three or four minutes without intermission; but after throwing the fluid for about half a minute, a short time may be allowed for the patient to rest and wipe his tears, which generally flow very copiously. Then the operation may be continued again for another half a minute and so on for four or five times every day.

"**Amaurosis or the gutta serena** is thus defined. It is an abolition of the sight without any apparent cause or fault in the eyes. When it is owing to a decay or wasting of the optic nerve it does not admit of a cure, but when it proceeds from a compression of the nerves by redundant humors these may in some measure be drained off and the patient relieved. Of late electricity has been much celebrated as efficacious, when no other thing could be of service."

In another place the author again says: "The gutta serena has often been cured by electrization; but at the same time it must be confessed it has proved ineffectual in many such cases in which it was administered for a long time with every possible attention. However, it never hath been known that anybody was made worse by it. The best method of administering electricity in such cases is first to draw the electricity with a wooden point for a short time, and then to send about half a dozen shocks of one-twentieth of an inch from the back and lower part of the head to the forehead, very little above the eye.

"A remarkable disease of the eye was some time ago perfectly cured by electrization; it was an opacity of the vitreous

humor of the eyes. This seems to be the only case of the kind to which electricity was applied.

"**All the cases of fistula lacrymalis** which Mr. Cavallo hath known to have been electrified by persons of ability, for a sufficient time, have been entirely cured. The method generally practised has been that of drawing the fluid with a wooden point to take very small sparks from the part. The operation may be continued for about three or four minutes every day. It is remarkable that in these cases, after curing the fistula lacrymalis no other disease was occasioned by it, as blindness, inflammation, etc., by suppressing that discharge.

"**Ulcers or open sores** of every kind, even of long standing, are generally disposed to heal by electrization. The general effects are diminution of the inflammation, and at first a promotion of the discharge of properly formed matter, which discharge gradually lessens, according as the limits of the sore contract, till it is quite cured. In these cases the gentlest electrization must be used in order to avoid too great an irritation, which is generally hurtful. To draw or throw the fluid with a wooden or even a metal point for three or four minutes a day is absolutely sufficient.

"**Cutaneous eruptions** have been successfully treated with electrization, but in these cases it must be observed that if the wooden point is kept too near the skin so as to cause any considerable irritation, the eruption will be caused to spread more. But if the point be kept at about six inches distance (or farther, if the electrical machine is very powerful), the eruption will be gradually diminished till it is quite cured. In this kind of disease the immediate and general effect of the wooden point is to occasion a warmth about the electrified parts, which is always a sign that the electrization is rightly administered.

"**Scrofuluous tumors** when they are just beginning are generally cured by drawing the electric fluid with a wooden or metal point from the part. This is one of those kinds of diseases in which the action of electricity requires particularly the

is very beneficial, whereas in the latter it may be attended with very disagreeable results. It is therefore a matter of great importance to ascertain the real cause of the disease before the electricity be applied.

"In the real suppression of the menses, small shocks, *i.e.*, of about one-twentieth of an inch, may be sent through the pelvis, sparks may be taken through the clothes from the parts adjacent to the seat of the disease; and also the electric fluid may be transmitted by applying the metallic or wooden extremities of two directors to the hips in contact with the clothes, part of which may be removed in case they are too thick.

"These various applications of electricity should be regulated according to the constitution of the patient. The number of shocks may be about twelve to fourteen. The other applications may be continued for two or three minutes, repeating the operation every day. But either strong shocks or a stronger application of electricity than the patient can conveniently bear should be carefully avoided, for by those means sometimes more than sufficient discharge is occasioned which is not easily cured.

Pregnant women may be electrified for other diseases, but always using very gentle means and directing the electric fluid to other parts of the body distant from those subservient to generation.

"In cases of **uterine hemorrhages** it is not known that the application of static electricity was ever beneficial, either that it has been often tried. Perhaps a very gentle electrization as to keep the patient insulated and connected with a prime conductor while the electric machine is in action may be of some benefit.

"In respect to **unnatural discharges** and **fluxes** in general it must be observed that some discharges are quite unnatural or adventitious (as the fistula lachrymalis and some species of venereal disease); but others are only increased natural discharges, such as the menses, perspiration, etc.

"Now the power of electricity in general has been found more

beneficial for the first than for the second sort of discharges, which are mostly increased by it.

"**Palsies** are seldom cured by means of electricity, especially when they are of long standing and the intellect is affected; but they are generally relieved to a certain degree.

"The method of electrization in these cases is to draw the fluid with a wooden point and to draw sparks through flannel, or through the usual coverings of the part if these be not too thick. The operation may be continued for about five minutes per day.

"**St. Vitus' Dance.**—The application of electricity has perfectly cured various cases of St. Vitus' dance, or of that disease which is continuously called so; for it is the opinion of some learned physicians that the real disease, which formerly was more frequent than it is at present, is different from that which now goes under that name.

"In this disease shocks of about one-tenth of an inch may be sent through the body in various directions and also sparks may be taken. But if this treatment prove very disagreeable to the patient then the shocks must be lessened and even omitted, and instead of them more gentle applications must be substituted.

"**Pulmonary inflammations,** when they are in the beginning, electrization has sometimes been beneficial, but in confirmed diseases of the lungs I do not know that it ever afforded any unquestionable benefit. However, it seems that in such cases it has but seldom been tried.

"**Dropsy.**—The application of electricity has often been found beneficial in dropsy when just beginning, or rather in the tendency to dropsy; but it has never been of any use in advanced dropsies.

"In such cases the electric fluid is sent through the part in various directions by means of two directors, and sparks are also drawn across the flannel of the clothes, keeping the metal rod in contact with them and shifting it continually from place

to place. This operation should be continued for at least ten minutes, and should be repeated once or twice a day.

"Perhaps in those cases a simple electrization—viz., to insulate the patient and to connect him to the prime conductor while the machine is in action—continued for a considerable time, as an hour or two, would be more beneficial.

"**Venereal Disease.**—In this case electrization has been generally forbidden, having mostly increased the pain and other symptoms rather than diminished them. Indeed, considering that any sort of stimulus has been found hurtful to persons affected with that disorder it is no wonder that electricity produced some bad effects, *especially in the manner it was administered some time ago,* viz., *by giving strong shocks.*

"However, it has lately been observed that a very gentle application of electricity, as, drawing the fluid from the metal or wooden point, is peculiarly beneficial in various cases of this kind even when the disease has been of long standing.

"Having remarked elsewhere that tumors when just beginning are dispersed and that unnatural discharges are gradually suppressed by a judicious electrization, it is superfluous to describe particularly those states of the venereal disease in which electricity may be applied. It is only necessary to remind the operator to avoid any considerable stimulus in cases of this sort.

"The application of electricity has been found also beneficial in other diseases besides those mentioned here, but as the facts are not sufficiently numerous so as to afford the deduction of any general rule, we have not thought proper to take any particular notice of them.

"We may lastly observe that in many cases the help of other remedies to be prescribed by the gentlemen of the faculty is required to assist the action of electricity which by itself would perhaps sometimes be useless; and on the other hand electrization may be often applied to assist the action of other remedies, such as sudorific, strengthening medicines, alteratives, etc."

This judicious and conservative article is exceedingly interesting, and would require very little alteration if written in 1897, instead of more than a century ago. It will be noted that violent shocks are as much condemned as they are to-day, and mild measures are especially recommended. In no way does the writer seem carried into enthusiastic extravagance by his subject.

CHAPTER VI.

IMPROVEMENTS IN ELECTRICAL APPARATUS IN 1789.

Prediction of future developments. An estimate of the value of static electricity in medicine. Safety of administration demonstrated by clinical experience.

It is not a little diverting in 1897, when conservatism is scarcely restraining the many still marvellous predictions for the future, to listen to Mr. W. H. Hall upon the subject of electricity in 1789. The following extracts are quoted from an elaborate article of that date in an English publication.

"Since the time of this discovery (the Leyden jar, 1745) the prodigious number of electricians' experiments, and new facts that have been daily produced from every corner of Europe and every part of the world is almost incredible. Discoveries have crowded upon discoveries, improvement upon improvement, and the science ever since that time has gone on with so rapid a course and is now spreading so unusually fast that it seems as if the subject will soon be exhausted and electricians arrive at the end of their resources.

"But, however, the *Ne plus ultra* as yet is in all probability at a great distance, and the young electrician has a vast field before him, highly deserving his attention and promising further discoveries, perhaps equally or more important than those already made."

That the prophetic vision of this judicious and hopeful writer did not lead him astray has been amply demonstrated both in mechanical and medical electricity. The telegraph, the telephone, phonograph, electric light, electric motor power, electroplating, electrolysis, electric photography, the electric dynamo, the electrical X ray, th ic and faradic and

their manifold medical uses, have all been given to the world by the ingenuity of men who lived long after this author's time. The same interesting writer goes on to say that:

"In regard to the other great uses of electricity, viz., its application as a medicine, there have been many opinions *pro* and *con.*, and the reputation of medical electricity has been very dubious and fluctuating, owing to the exaggerations, mistakes, prejudices, and the interests of those who have administered it in physical cases. But after many experiments, and after overcoming the rooted prejudice of several physicians against medical electricity, it has been clearly observed that when properly managed it is a harmless remedy, which sometimes instanteously removes divers complaints, generally relieves, and often perfectly cures various disorders, some of which could not be removed by the utmost endeavors of physicians and surgeons. Electricity when properly managed, if it does not effect a cure, at least produces no bad effect. The few cases in which it seems to have produced any harm are of a doubtful nature."

In reference to the safety of administering static electricity we may go back again some years and quote the following extract from the works of John Wesley. After he records his experience in several thousand cases he states:

"Nor have I yet known one single instance where it has done harm, so that I cannot but doubt the veracity of those who have affirmed the contrary. Dr. De Haen positively affirms it cannot do harm in any case, that is unless the shock be immoderately strong."

CHAPTER VII.

THE CELEBRATED GUY'S HOSPITAL REPORTS.

Static electricity in convulsive and spasmodic diseases reported by Dr. Addison. Addison's estimate of the value of static electricity. Methods employed. Cases of chorea, with clinical histories and results of treatment. Hysterical paralysis. A clinical case. Further cases of chorea, with details of treatment and results.

PROBABLY the most famous landmark in the historical narrrative of static therapeutics consists of the celebrated reports of Guy's Hospital by Addison (1837), Golding Bird (1841), and Gull (1853). Allusion is made to them in nearly all the later writings upon this subject, and they may be fairly credited with having exerted a great influence upon the revival of the abandoned static machine.

The original reports are not readily accessible to the general physician and probably few in our day have read them. They fully deserve our attention, however, both for the influence they exerted when first published and for the intrinsic interest which they now possess; and we shall accordingly place before our readers the essential portions of these reports.

ON THE INFLUENCE OF ELECTRICITY

AS A REMEDY IN CERTAIN CONVULSIVE AND SPASMODIC DISEASES.

BY DR. ADDISON (1837).

It must have occurred to every one engaged in extensive practice to meet with cases of convulsive and spasmodic disorders affecting females, and with cases of chorea in both sexes which, while they occasion extreme distress to the patient and to the patient's friends, have baffled every attempt to afford permanent, and, in some instances, even tempo[illegible]f.

It was while brooding over the humiliating failure of a host of remedies employed in one of such cases, and which will be described in the sequel, that, as a last resource, I determined upon giving electricity a fair trial.

I was perhaps, in some measure, induced to do so in consequence of having an opportunity of securing the assistance of Mr. Golding Bird in its application. The effect produced by it at once gratified and surprised me, and led to further trial, the results and particulars of which will not, I trust, be deemed altogether unworthy of the profession.

Of course, all claim to originality or even novelty is out of the question, electricity long having been enumerated among the ordinary remedies applicable to convulsive disorders generally.

It is nevertheless much to be feared that many persons like myself have been led greatly to underrate its efficacy, either in consequence of its vague and indiscriminate recommendation, or from the inefficient and careless manner in which it has been applied.

Certain it is that although I have often ordered it myself, and have more frequently witnessed its employment by others, I had never for a moment entertained the belief that it possessed the power over the disorders alluded to which I am now inclined to concede to it.

It is almost superfluous to observe that the convulsive and spasmodic disorders of females alluded to are such as, in a large majority of instances, are connected with some irregularity of menstruation; neither is it necessary to dwell upon the difficulty of distinguishing merely functional from organic diseases of the nervous centres; these being matters with which the profession at large is perfectly familiar.

It is but right to state that the following cases have not been selected because the treatment proved more or less successful, to the exclusion of others in which it failed. On the contrary they comprise the whole of the cases hitherto subjected to the

electrical process about to be described and hence afford, as far as they go, a fair promise of at least occasional benefit from the application of this powerful agent in the treatment of the diseases specified.

However undesirable it may be to encumber our reports with a detailed history of cases, such a mode of procedure becomes almost indispensable in the present instance; but in order that the length of this communication may not greatly exceed its importance, I shall without further comment proceed to lay before the profession a brief description of the mode in which electricity was applied.

In the following cases the form of electricity employed was that elicited by the common electrical machine; being made use of either by taking sparks in the course of the spine, or in the form of shocks passed through the pelvis.

In the former case the patient was seated on an insulating stool and a metallic connection made between the prime conductor of the machine and the body of the patient. A brass ball furnished with a wire or chain in connection with the earth was then passed upward and downward in the direction of the spine at a distance of about one inch from the surface. The machine being now excited, the patient became charged, and the electricity continued to pass off, accompanied by sparks, to the brass ball, and thence escaping through the medium of the wire or chain to the earth.

In this manner a rapid succession of sparks could be maintained, and which in the present instances was continued until the eruption followed which assumed very much the appearance of lichen urticatus; the time necessary for its production varying in different patients from five to ten minutes.

[Here follows a description of Leyden-jar shocks, which we shall omit and proceed at once to the report of cases.]

Chorea with Epileptic Convulsions.—Jessie Wick, aged 17, admitted May 14th, 1837, a stout, intelligent, well-developed girl of rather nervous temperament. In general good health

till about fourteen years of age, at which time, being of remarkably forward sexual developments, she began to menstruate. The catamenial discharge immediately became irregular, recurring every fortnight, lasting three days and accompanied by acute pains in loins and genital organs. She does not appear, however, to have suffered materially in her health from this irregularity.

Two months since and while menstruating she suffered a violent fright, which was immediately followed by cessation of the discharge, hysterical fits, and continued trembling of the limbs, rendered much worse by any excitement.

She was, when admitted, utterly unable to remain in a state of rest for a moment, her limbs, especially the upper limbs, being violently agitated. Her mouth is from time to time ludicrously distorted. The most unvarying motion was a rolling of her clinched hands quickly around each other, with the thrusting forward of the right hand in a very systematic manner, it occurring after every third revolution. Deglutition and speech but slightly affected. Occasional pains in head and loins and under left mamma, palpitation, but no abnormal heart sound. Spirits good, but she is fatigued from the continued action to her muscles.

Purgatives, antispasmodics, etc., were administered without any abatement occurring in her symptoms. Her nights were sleepless and her irritability became excessive. On May 20th her catamenia reappeared, being somewhat delayed, scanty, and painful. It ceased again at 2 A.M. of the 21st. Her condition grew rapidly worse. On August 15th, having been just three months in the hospital, she quitted it, and for two months we heard little of her, but on October 15th she appeared among the out-patients at Guy's Hospital in a much worse condition than she had ever yet been. From her friend's statement it appeared that before reaching her destination she had been seized with epileptic fits, which she had never experienced before. They had been severe and left her with a foolish, imbecile stare, the face dull, and she appeared to be almost regardless of surrounding objects. Articulation was lost and she made no attempt, even by signs, to express her feelings. During the epileptic paroxysms she had violent opisthotonos, the occiput almost meeting the heels; firm contractions of flexors of the fingers and toes, with equally firm contraction of extensors of the forearms and legs; much thick foam from the mouth; stertor; largely dilated pupil; the heart's action was quick and tumultuous with an anæmic murmur distinctly heard at its apex.

weeks and since then has had periodical returns, the attacks generally observing the recurrence of the spring and autumn. The present attack is not severe, but interferes with progression, and slightly with speech. She complains of severe headache, and her temper is irritable.

The following treatment was ordered:

Elec. scintillæ electricæ spina dorsi.
Pulv. rhei et calomel, gr. xij., *p.r.n.*

The sparks were drawn off at the distance of three-eighths of an inch till the peculiar eruption was produced. After the fourth or fifth trial the speech became distinct and the walk almost quite steady. There were still, however, twitchings of the arms, shoulders, and muscles of the face. At the end of the third week they had all entirely ceased in the order above enumerated. Two doses of the rhubarb and calomel had been administered during this period.

Chorea.—William Sutton, aged 14, a healthy-looking but rather small boy, admitted on May 10th. He states that he has been three times affected with chorea. The first attack occurred upon a fright caused by a vicious horse pursuing him. For this attack he was under treatment in the hospital for six weeks when he left cured. Twelve months subsequently he had another attack, which, although of longer duration than the former, was much less violent. He was again admitted to the hospital and left when cured.

At the commencement of the present year he suffered from a third invasion, which he describes as of a more serious character than either of the former. At present he is unable to remain quiet a moment. He can walk, but his legs bend about frequently while he is doing so. He is continually thrusting his hand along his side. The face is more violently affected than other portions of the body.

Zinc, with purgatives, was administered with but little benefit till June 19th, when upon his coming under Dr. Addison, static electricity was ordered to be applied daily along the spinal column. This plan was persevered in until July 11th, when every symptom of chorea having disappeared, and his general health being good, he was discharged.

Hysterical Paralysis.—Matilda Simmons, aged 16, of delicate appearance, light brown hair and eyes, mammæ well developed, has been at service in London, and previous to menstruation a year ago she felt the ordinary symptoms attending a delay of that function, headache, palpitation, shooting pains,

etc. For six months the catamenia appeared regularly. They were then arrested by a cold, and the former symptoms then recurred, and were soon accompanied with numbness and coldness on the whole left side. This was immediately preceded by a fit, which from the account of her friends appears to have been one of the truly hysterical character.

Ten days before admission the face, which had hitherto escaped, became numb on the left side, the sight of the left eye became dim, and there was a slight pain in the eyeballs. On the third day there was perfect amaurosis and ptosis. At the time of her admission there was numbness, coldness, and deficient power over the whole of the left side, including the lining membrane of the mouth, nostril, and conjunctiva. In the latter she felt a burning sensation, but could not distinguish a touch. The pupil was contracted and did not react to light. She could not raise the upper eyelid. She complained of pain in the head and giddiness, bowels torpid. Treatment was continued for some time.

April 24th: Dr. Addison ordered electricity in the shape of sparks down the spinal column. On the same evening she could bend her fingers; on the 27th she recovered to a certain extent power over the muscles of the arm. April 29th: The third application was made yesterday, with the result of restoring vision and the power of elevating the upper eyelid, increasing the strength of the arm and improving to a certain extent motion and sensation in the leg.

May 4th: Improvement continues; she can walk without difficulty, experiences no numbness, but complains of tingling in fingers of left hand. The left eye remains as it was when she was admitted.

June 12th: The form of applying electricity has been changed during the last ten days, sparks being drawn from the left eyelid, and shocks being passed through the pelvis. There is no improvement in the eye, which remains perfectly amaurotic, but the catamenial function was restored yesterday morning, and was not preceded or accompanied by any particular symptom. Her general health being good, she has left the hospital at her own desire.

Chorea.—Annie Bosher, aged 21, a stout, short girl of rather heavy expression, with dark hair and eyes. Her health previous to the present illness has been always good; her family, however, is not a sound one, a cerebral disease affecting several members of it. A sister had chorea, but she had no recollection of it. At the age of sixteen the loss of her

mother affected her seriously, and about the same time a large abscess formed under the left inferior maxilla, which remained some time open and discharged freely. The menses then appeared and continued regular in recurrence and quantity till the age of nineteen, when she was suddenly seized with severe pain in the back of the head accompanied by a loss of recollection. A physician was called in who used a very large depletion.

After confinement to bed for six weeks this attack yielded, but she was left excessively languid with severe pains in loins and right leg, irregular menstruation, and diminished muscular power. Some weeks subsequently her right hand became affected with involuntary twitching, which gradually extended itself to the whole body, but more particularly to the right side, and at length her agitation was so violent that straps were required to keep her in bed. Speech and deglutition were greatly impaired, and the muscles of the face and eyelids were in constant action. She had no fit during this period, but the headache was distracting.

Medical aid was procured, but to no purpose. She was then admitted to St. Thomas' Hospital, and while there had some sharp epileptical attacks. She remained in that hospital ten months, and then quitted it not much benefited, although at one time she had greatly improved. She was immediately admitted into the charity ward, at which time she could with difficulty be retained in bed. She could not walk or indeed even stand; neither could she remain quiet for a moment. Her epileptic seizures were frequent and severe; recollection impaired; deglutition and articulation imperfect; the right side is now, and has been always, more seriously affected than the left, and she complains of headache with pain in the back and loins.

In this state she remained with very slight improvement, in spite of a host of remedies, comprising cold to the head, blisters and cupping to the spine, drastic purgatives, iron, zinc, and many others.

June 12th: Electricity daily over the spine was prescribed, the bowels to be regulated by an occasional purgative. This treatment has been steadily persevered in (being only once or twice interrupted by her fits), and with very evident benefit. The catamenia has reappeared although only for a few hours; her headache has considerably decreased, and her memory has improved; the fits seldom trouble her, and her muscular power is so much restored that she can not only walk about the

ward without assistance and without much difficulty, but can carry a cup pretty full of liquid without spilling the smallest quantity. There is still, however, a little twitching of the extremities, and the right side remains yet more agitated than the left. The treatment is ordered to be continued.

Chorea.—Sarah Kidd, aged 16, tall, of slight make, dark hair and eyes, swarthy complexion, prominent eyes, and fatuous aspect. Admitted February 18th, 1837. Her family are all suffering from derangements of the nervous centres. One is blind, two epileptic, and another both idiotic and blind. She has always been weakly. The catamenia appeared twelve months ago, preceded by considerable pain, but were arrested in about two hours by some one in disguise alarming her. They have never appeared since, either naturally or vicariously.

Immediately after their cessation symptoms of chorea came on. The irregular and involuntary motions affected the neck and face. These increased so that the strait-jacket was employed to keep her in bed. Violent muscular agitation, frequent headaches, loss of articulation, and impairment of deglutition continued for five months in spite of medical treatment, which consisted chiefly of leeches to the temples and spine and use of the shower bath. Twice during this period she had severe aggravations lasting three or four hours, during which it was with difficulty that three or four persons kept her in bed. At the end of five months she could walk about, but the twitchings never ceased. The shower bath was persisted in till the occurrence of an attack of acute rheumatism.

A fortnight ago, without any assignable cause, the twitchings became more vigorous. At present the aspect is fatuous though occasionally wild, and occasionally almost maniacal. The symptoms of chorea are well marked and severe. The pupils are dilated, eyesight dim, and sweating profuse. The following treatment was then ordered.

Pulv. rhei et cal., ...	℈ i. *statim.*
Zinci sulph., ...	gr. i. *t. i. d.*
Pulv. aloes et myrrh., . . .	℈ i. *alt. noctibus.*

The symptoms remained obdurate. Colchicum in powdered form was given as a purgative, and continued for some days after the peculiar pea-soup stools had been induced. Valerian and iodide of iron were not more successful.

April 20th: Static electricity was begun. Sparks were drawn from the spine and shocks passed through the pelvis.

April 29th: The sparks induced a variegated eruption without papulæ, her skin being very thick. There is much less twitching of the shoulder and the hands are more steady. Muscæ volitantes still float before her eyes. She looks more cheerful and feels generally better.

May 2d: Is rapidly improving. She can walk now several steps without falling. Each electric shock produces extreme muscular spasms.

Within a day or two of this date all traces of involuntary muscular action disappeared. Her gait, however, remained stiff and ungainly. This was explained by the anatomy of the knees, the patellæ being ill developed, not above one-third of their natural size and seated several inches above their natural position. Very slight flexion is possible, and the attempt causes pain. The dimness of vision and muscæ volitantes have quite disappeared.

May 20th: Discharged cured.

Chorea.—Frances Shead, aged 12, an active, intelligent girl of moderate height and stoutness; admitted April 12th, 1837. She has had most of the ordinary diseases of childhood, and without any very apparent cause has suffered frequently from headaches, chiefly confined to the occipital region. During the last three months this symptom has increased, and she has likewise had nocturnal pains in the eyes, disturbing her rest, dimness of vision, and muscæ volitantes; menstruation not yet developed.

On March 24th she was much alarmed by a cat flying at her, and from this period her friends can date slight irregular movements of the hands. These continued for about a week; a paroxysm of pain in the forehead then occurred, confined to its old spot, and so excessive that she threw herself down and screamed violently. This ushered in increased muscular agitation, not confined to the arms, but affecting the whole body. Locomotion became difficult, articulation and deglutition became much impaired, respiration difficult and laborious, the expiration being attended with a snorting sound.

At present these symptoms are in full force: the countenance is vacant; there is headache, pain in the right ankle and wrist, general and continued muscular spasms, affecting both sides equally but most intense in the shoulder, arms, and face. The tongue is broad, slightly furred, its muscles under no control; pulse 100, and feeble; appetite good; a slight bellows sound is heard over the root of the aorta; upon the neck and back a number of boils are forming, owing apparently to

stimulating applications which had been made before her admission.

℞ Scammon., ...	gr. v.
Hyd. submur.,	
Sacch., ...	āā gr. iiss.
Stat. et alt. auror.	
℞ Zinci sulph., ...	gr. i.
Ext. conii, ...	gr. ij.
T. i. d in pill form.	

April 17th: It was necessary to administer zinc in solution, owing to her inability to swallow anything solid. Articulation is now quite inaudible. The boils continue to form, and when open discharge pus and sloughing cellular membrane. During sleep, which is not much disturbed, there is slight twisting of the finger. Increased pain and convulsion come on in paroxysms.

April 20th: The zinc has been increased to eight grains three times a day without the slightest benefit.

Dr Addison now ordered electrical sparks down the spine every other day.

April 28th: Electricity has been applied four times, and with marked benefit. It is continued each time for about ten minutes until a vivid eruption appears, closely resembling lichen urticarius, though scarcely so much raised. She can now project the tongue, though only for an instant, and articulate audibly Deglutition is more comfortably performed. She can sit in a chair and even stand for a short time. The pain in the head is diminished.

May 12th: She can now walk without difficulty and stand on one leg for a short time. The shoulders, arms, and tongue are now the most affected.

May 16th: The electricity is still continued and the improvement is uninterrupted. She can now walk without any irregular movement. The countenance has entirely lost its tetanous expression. She cannot keep the tongue protruded.

May 31st Discharged quite free from all traces of chorea.

August, 1847: She was again admitted under Dr. Bright with a very mild return of the disease, not sufficient to interfere with her ordinary pursuits. The sulphate of zinc was ordered and she left in twenty days cured.

CHAPTER VIII.

VALUE OF STATIC ELECTRICITY AS A REMEDIAL AGENT IN THE TREATMENT OF DISEASE, BY GOLDING BIRD, M.D., A.M., F.R.S., ETC.

Methods of clinical management. A demonstration of physiological effects. Table of thirty-six cases of chorea. Clinical history of cases of chorea, with results of treatment by static electricity. Shocks to the affected limbs contra-indicated in chorea. Involuntary motion of the lower jaw producing repeated dislocations—relief by static sparks. The value of static electricity in chorea discussed in detail by Dr. Bird. His view of its curative action.

So many discrepant statements exist in the records of medicine regarding the action of static electricity as an agent in the treatment of disease that scarcely any general opinion can be drawn regarding its real influence.

In the hands of some it has appeared to possess an almost magical action in the most intractable diseases; while others, equally worthy of confidence, have declared it to be utterly worthless.

In October, 1836, the treasurer, Mr. Harrison, set apart a room in the hospital for the exclusive use of electricity, all apparatus in which is kept in thorough working order. The out-patients and those in wards attend this room daily at three o'clock. Notes of their cases are taken by one of the students, who acts as clinical clerk. A competent female attendant applies the electricity to female patients. In this manner every case is registered, its progress watched by the pupils, and any change in the treatment is directed by myself, for which purpose it is my duty to attend two days during each week.

Having from the time this plan was commenced in 1836 had

a large number of cases treated in the electrical room, I consider that the report of the results of their treatment would neither be useless nor unacceptable to the profession, especially as there does not exist, so far as I am aware, any account of modern date of the results of the application of electricity in this country on anything like an extended scale, save some that partake too much of empiricism to be worthy of confidence.

Static electricity and galvanism, it must be borne in mind, are but different names of one and the same agent, the only real difference being that in the electricity of the electrical machine we have the peculiar imponderable matter in smaller quantity, but in a state of high tension or elasticity, while in galvanism we obtain it in enormous quantities but in a state of low tension. [Here follows a description of the electric charge, or static bath, which I omit.]

The evolution of heat during this silent discharge is sufficient to demonstrate the mode in which its physiological effects * alluded to are produced, and was, I believe, first pointed out by a pupil of my class, Mr. Thomas Smith, who performed the duties of clinical clerk in the electrical room with the greatest zeal and discretion during several months.

This gentleman coated the bulb of a delicate air thermometer with tinfoil, and connected it with the conductor of an electrical machine. Silent discharge took place from the coated portion and the colored fluid fell in the tube upward of an inch from the expansion of the included air by the heat evolved. [Here follows a description of the spark and shock applications, which I omit.]

The cases now reported occurred in the hospital from October, 1836, to December, 1840, inclusive.

* During discharge heat is evolved, the circulation becomes quickened, the secretions generally become more active, and perspiration breaks out.

TABLE OF CASES OF CHOREA.

No.	Name.	Age.	How long ill.	Character.	Apparent cause.	Result.
1	Frances Shead...	12	3 weeks.	Universal.	Fright.	Cured.
2	Sarah Kidd.....	16	12 months.	Universal.	Sudden arrest of menses.	Cured.
3	Jessie Wick.....	14	.....	Complicated with epilepsy.	Fright.	Cured.
4	Emma Hillier....	14	4 years.	Universal.	Epileptic fits.	Cured.
5	Ann Baker.....	21	2 years.	Complicated with epilepsy.	Excessive loss of blood in previous illness.	Cured.
6	Wm. Sutton	14	6 months.	Universal.	Fright.	Cured.
7	Harriet Witham..	8	6 weeks.	Universal.	Rheumatism.	Cured.
8	Jas. Treeby	18	2 months.	Right side.	Exposure to cold.	Cured.
9	Geo. Eden.....	12	4 weeks.	Universal.	Fright.	Cured.
10	Wm. Price.....	12	.....	.....	.....	Cured.
11	Wm. Jordan....	12	10 months.	Universal.	Irritation of tænia.	Cured.
12	Joan Corbyn....	14	3 months.	Universal.	Terror from confinement in cellar.	Cured.
13	Sarah Watts.....	..	.....	.....	.....	Cured.
14	Mary Smith	9	5 weeks.	Universal.	Intestinal irritation.	Cured.
15	Moses Mills.....	9	14 days.	Universal.	Fright.	Relieved.
16	Maria Phipps....	18	3 weeks.	Universal.	Terror from a dream.	Relieved.
17	Eliza Trimming..	19	1 month.	Universal.	Fright.	Cured.
18	Eliza Raven	16	3 months.	Right side.	Amenorrhœa.	Cured.
19	Eliza Edwards...	17	5 months.	Upper extremities.	Amenorrhœa.	Relieved.
20	Robert Carr.....	15	?	Right side.	Intestinal irritation.	Cured.
21	Martha Dufy	11	3 months.	Left side.	Fright.	Cured.
22	C. Calthorpe.....	8½	?	Universal.	Fright.	Left from alarm.
23	Emma Stroud....	14	4 months.	Universal.	Fright.	Cured.
24	Sarah Wheeler...	12	5 weeks.	Right arm.	Fright.	Cured.
25	Henry Mason....	40	.....	Neck only.	Exposure to severe cold.	Cured.
26	C. Deacon.....	9	2 months.	Universal.	Terror from confinement in cellar.	Cured.
27	Mary Shearman..	15	2 months.	Right side.	Terror from house being on fire.	Cured.
28	Mary Coffee.....	9	?	Universal.	Fright.	Cured.
29	Benj. Smith	61	5 months.	Universal.	?	No relief.
30	Emma Kenney...	11	?	.....	Fright.	Cured.
31	Jas. Townsend ..	40	2 years.	Lower jaw.	Injury.	Relieved.
32	Jas. Spriggs.....	39	39 years.	Fingers and hand.	Congenital.	Relieved.
33	John Brett.....	14	4 months.	Universal.	Epilepsy.	Cured.
34	Eliza Jay.....	11	1 year.	Universal.	Grief.	Cured.
35	Jas. Button.....	8	5 months.	Universal.	?	Cured.
36	Geo. Baker.....	13	10 weeks.	Right side.	Fright.	Cured.

NOTE.—In 1853 Sir William Gull, M.D., in a third notable contribution to the Guy's Hospital reports, makes the following just observations: "In the fifth number of these reports Dr. Addison contributed a valuable paper 'On the Influence of Electricity in Certain Convulsive and Spasmodic Diseases,' and there recorded several cases of chorea successfully treated by electricity. The illustrations were not numerous, but they were unequivocal and sufficient to render it highly probable that electricity was in fact a remedial agent in this disease.

"Further evidence tending to confirm the results already obtained was given by Dr. Bird in his report in the twelfth number. He there gives a table of thirty cases—twenty-three cured, five relieved, one not relieved, and one 'left from alarm.'

"On looking critically at this table, the results require some modification.

"The case not relieved was probably not chorea, but paralysis agitans, occurring as it did at the age of 61. The other said to be limited to the 'sterno-cleido-mastoid muscle' is the affection commonly known as 'spasmodic wry neck' and should not be classed with chorea, but rather with paralysis agitans, or, in-

The above table includes a sufficient number of cases to enable the reader to draw his own deductions from the results of treatment. It must be borne in mind that in many of the cases remedies were given during the application of electricity, and thus the reports of such cases lose a certain amount of their value. But in the majority of instances these remedies were but occasional mild purgatives, and it must not be forgotten that, in very many of the cases here related, every variety of treatment had been tried before the patients were admitted into the electrical room of the hospital.

Some few of the cases (Nos. XXV., XXI., XXXII.) may perhaps be regarded as scarcely instances of chorea, but as they are cases of involuntary muscular movement I have not hesitated to admit them. The first six cases on the list have been previously reported by Dr. Addison, and they afford valuable evidence of the utility of electricity as a remedy in chorea.

In every case admitted into the electrical room I have confined the treatment to sparks on the spine every alternate day for about five minutes each time, or until the papular eruption appears. I have very frequently found the disease to be somewhat increased at first from the alarm of the patient, but this rapidly subsides, and in general merely with an occasional purgative the cases have rapidly progressed toward cure. It is, indeed, notorious that remedies of this class, mild purgatives, often produce a considerable alleviation of the paroxysm of chorea and occasionally are sufficient to cure the disease without other remedies. Still this is not the constant result.

The following are some of the most interesting cases in the table:

CASE I.—**Chorea Following Rheumatism.**—Harriet Witham,

deed, occupy a place by itself. If we except these cases, the results of the other twenty-seven are: twenty-two cured; five relieved. Here we have therefore great confirmatory evidence of the results offered by Dr. Addison. Its value would have been greatly enhanced by a fuller account of [illegible]uring which electricity was employed, [illegible]ere is no mention in [illegible]In all the cases reported in full th[illegible]ver, accurately gi[illegible]

aged 8, a thin but healthy child, whose previous health had been good. States that about six weeks ago she was suddenly seized with great pain in her legs, of which she lost the use. Under medical treatment the pain left the leg and attacked the abdomen and then the arms. The joints do not appear to have been much swollen or red. She recovered in a month, and almost immediately became the subject of chorea, and was admitted to Guy's Hospital, November 2d, 1837.

Her present symptoms are continuous involuntary jactitation of the legs and arms with continual contortion of the muscles of the face. She complains of stiffness in the neck, speaks with extreme difficulty; took wine of iron and zinc sulphate for some time, but getting no better, electricity was ordered on December 2d.

December 8th: The sparks have been taken daily from the spine. She now speaks and swallows without the slightest difficulty. The involuntary movements of limbs are much diminished.

December 18th: She left the hospital quite free from all traces of chorea.

She remained well until June 20th, 1838, when she was brought to the hospital with chorea, confined now to the upper extremity. The electricity was again ordered, and she rapidly got well.

CASE II.—**Chorea Apparently Arising from Tænia.**—William Jordan, aged 12, a fine lad. He states his general health to be good. Has long been subject to tapeworm. He has never had rheumatism or suffered from fright. His present attack commenced ten months ago, and although he has been under treatment nearly the whole time has never been much relieved.. He therefore applied to the hospital and was admitted November 1st, 1838. He took purgatives and sulphate of zinc for two months, and not being any better, he was sent to the electrical room January 6th, 1839. At that time his symptoms were the following: Involuntary movements of almost every muscle, so that he had considerable difficulty in walking and was quite unable to support himself on one leg; his arms were in constant motion, and he had so little control of his fingers that he could not retain his grasp on an object, even for an instant. The muscles of his throat were also in a constant state of involuntary motion, so that his articulation was imperfect and his words often unintelligible. His head was constantly moving, being, with his neck, alternately thrust forward and retracted in

a jerking manner. Sparks were ordered to be taken from his spine on alternate days.

January 9th: Much improved. Involuntary movements of leg and arm are less.

January 13th: Rapidly convalescing.

February 9th: Discharged well.

CASE III.—**Chorea Depending on Amenorrhœa.**—Elizabeth Raven, aged 16, of previous good general health, menstruated for the first time three months ago. After the disappearance of the discharge she became the subject of involuntary movements of the right arm and hand. These have increased in intensity up to the present time. She appeared at the electrical room July, 1838. Sparks were taken from the spine and a few shocks passed through the pelvis. After the electricity had been applied five times menstruation occurred and the chorea vanished. She continued well until September 19th, when, as the discharge had not appeared at its proper time, she again applied at the hospital. A few shocks passed through the pelvis excited the deficient functions, and she left quite well.

CASE IV.—**Chorea Limited to the Right Side.**—Mary Ann Shearman, aged 15, has been subject to chorea during two months, affecting right half of the body. Arm and leg of right side were in constant motion. The attack is attributed to a severe fright, in consequence of the house in which she lived having got on fire.

November 29th: Electricity ordered.

December 20th: Has attended regularly and is nearly well.

January 10th, 1840: She stopped coming since last date, and is now nearly as bad as ever. Electricity was begun again, and on February 28th she was discharged completely well.

Static electricity does not appear to be less useful as a remedial agent in cases in which involuntary movements are confined to a single limb or to a few muscles of the body only. It will be unnecessary to give more cases of ordinary chorea, as they stand recorded in the hospital case books, and I shall therefore content myself with relating a few cases of the rarer forms of chorea in which the disease is extremely limited in its seat.

CASE V.—**Chorea Limited to Right Upper Extremity.**—Sarah Wheeler, aged 12, admitted November 5th, 1839, has been subject to chorea five weeks. Disease limited to the right arm

and shoulder, the limb being in a state of perpetual movement. Cause, fear produced by threats of her schoolmistress. She took for some time sulphate of zinc and sesquioxide of iron, and then attended the electrical room. Sparks were taken from the spine three times with considerable benefit, when she left the hospital. On December 20th she again appeared at Guy's. The involuntary movements were as bad as ever. Some saline rhubarb powder was ordered as an occasional aperient. Sparks from the spine three times a week.

January 14th, 1840: She has attended regularly, improved daily, and to-day was discharged quite well.

CASE VI.—**Chorea Apparently Confined to Sterno-Mastoid Muscles.**—Henry Mason, aged 40, fine, stout, healthy-looking man, engaged until recently as a country traveller for a large commercial house. He has lived freely and has been exposed to frequent and sudden alternations of temperature. About eight years ago, during an extremely cold night in a severe winter, while driving in an open country in a gig, he was nearly frozen to death, and shortly after recovering from the partial stupor in which he was found was seized with an involuntary motion of the muscles of the right side of the neck. After an illness of nine months he recovered completely.

Within the past four months this affection has returned, and at this date he presents the following appearance: Every few minutes he is turned with a jerking, involuntary movement toward one side with such force and to such an extent as to threaten strangulation, the vessels of the neck becoming extremely turgid. In a short time this spasm ceases, and the head moves back to the ordinary position, being, however, in a few minutes carried to the opposite side. These motions he is obliged to control by seizing hold of his nose, using it as a lever to keep his head steady. And in fact, he usually walks about in this position, or with his arm raised, so as to seize hold of the nose on the accession of the involuntary movement. On the slightest excitement these motions increase to a distressing extent. They are absent during sleep.

He was ordered sulphate of zinc, which he took several weeks, the dose being carried up to eight grains three times a day without relief. The different functions of the body appearing to be well performed with the exception of a tendency to constipation, he was ordered an occasional dose of the saline rhubarb powder, and sparks were taken on alternate days from the spine and along the sternal mastoid muscles. He commenced this treatment early in December.

December 13th: He is considerably improved, can walk without using his hand to steady his head unless considerably excited.

December 20th: He has continued gradually to improve until a fortnight ago, when, deeming himself tolerably well, he ceased to attend and indulged in intemperance and irregular habits. On coming this day to the hospital he was much worse, the involuntary movements of head and neck having increased. Electricity was again ordered, and in a short time he became convalescent.

Clinical Remarks.—I have never seen any good effects to result in cases of chorea from the transmission of electrical shocks along the affected limbs. On the contrary, in every instance, the involuntary movements have thereby been increased, often to an alarming extent, and if employed when the patient was convalescing it has invariably aggravated every symptom, and often rendered the patient as bad as when first admitted to treatment. The following case is one in which shocks were employed in the hope of accelerating the cure, but with the opposite effect of increasing the malady.

CASE VII.—**Chorea Confined to the Right Side of the Body.**—James Treeby, aged 18, a stout, muscular lad. States that until the last two months his health has been excellent. His employment as toll-gate keeper has necessarily exposed him to changes of weather which have induced repeated catarrhal attacks, and to one of these he attributes his present illness. The involuntary movements first appeared two months ago, and are confined to the right half of the body, the left side being unaffected. They are sufficiently severe to prevent his retaining anything in his grasp, and to interfere materially with walking.

October 7th, 1838: Sparks from spine were ordered daily. No medicine.

October 12th: Improving rapidly. Involuntary movements occur, but are light. He can readily keep his right arm extended a minute or two.

October 23d: Scarcely a trace of involuntary movement of the arm is left. The legs still remain slightly affected. With a view of ascertaining whether the progress of the case toward

recovery would be accelerated, a few shocks were ordered to be passed along the leg and arm.

October 26th: He has grown rapidly worse since the employment of the shocks, and is now almost as bad as when admitted to the hospital. Sparks were again ordered to the spine alone, together with gradually increased doses of sulphate of zinc. In six weeks he was discharged cured.

The two following curious cases, though scarcely possessing the character of chorea, are sufficiently marked to allow them to be regarded as cases of that disease. They still point out in an interesting manner the influence that static electricity exerts over the involuntary movements of muscles supplied by spinal nerves.

CASE VIII.—**Congenital Chorea, Limited to the Fingers of Both Hands.**—James Spriggs, aged 45, a porter, came under my care in November, 1840, with an attack of gastric dyspepsia. My attention was attracted by a remarkable state of the hands of this patient. They were semiflexed on the forearm in the manner of the painter's dropped hand. The fingers were flexed on the hand and in a state of continuous motion, being alternately flexed and extended, occasionally performing imperfect rotatory movements like the arms of a chorea patient. On his mind becoming at all excited, or on directing him to keep his fingers still, the movements rapidly increased to such an extent as to prevent his grasping anything in his hand. During sleep these movements disappeared, and the hands generally remained half clinched. The thumbs were much more steady than the fingers. It was nearly impossible to distinguish the pulsations of the radial artery owing to the continued *subsultus tendinum*, under which this man constantly labored.

After relieving his dyspepsia I ordered him to Guy's Hospital to have sparks drawn from the upper half of the spine with the hope of relieving these distressing involuntary movements, and I was gratified by finding them remarkably diminished after his attending a fortnight,—so much so, indeed, that he can grasp a thin card between the finger and thumb and hold it for some little time. On inquiry I found that this curious affection was congenital, and had continued nearly without alteration from infancy to the time he came under my care (forty-five years).

CASE IX.—**Involuntary Motion of the Lower Jaw Producing Repeated Dislocations.**—James Townshend, aged 40, accidentally dislocated his jaw in the winter of 1838, and after its reduction became the subject upon the slightest excitement, and often without any apparent cause, of involuntary movements of the jaw, apparently referable to the pterygoid and the depressor muscles. These produced dislocations of the jaw, often several times a day.

October 9th, 1840: He was sent to the electrical room of Guy's. Sparks were drawn from the affected muscles with remarkable effect, the involuntary movements diminishing so considerably that dislocation of the jaw now rarely occurred. On leaving off the electricity the motions returned, and with them the spontaneous dislocation, but whenever he recommenced its use both these disagreeable symptoms vanished. He was subsequently admitted to the hospital, and under the use of graduated doses of zinc sulphate he got completely well, though as he only left the hospital one month ago there is yet no proof that the cure is permanent.

Conclusions.—It may now be asked, In what light is static electricity to be regarded in the treatment of chorea and certain involuntary motions of the voluntary muscles analogous to those occurring in this disease?

From the results of the cases treated at Guy's Hospital no doubt can remain in the mind of any one that electricity exerts a decided, not to say specific, influence on these affections, and although on its first application all the symptoms often become increased from probably the timidity of the patient and the novel character of the remedy, yet where it has been persevered in, as in thirty-five of the thirty-six reported cases, it has either completely cured (thirty-one were cured) or greatly relieved the patient. The case in which it failed (the 29th of the table), could scarcely be regarded as a fair one, as there was but little doubt that disease of the spinal cord existed.

I feel extremely unwilling to recognize the existence of any more specific agents than necessary. I would venture to suggest that electrical sparks when drawn from the spine may act by the irritation they produce; and this theory appears counte-

nanced by the fact that the rapidity with which the patient's symptoms are relieved is nearly in a ratio with the facility with which the peculiar papular eruption makes its appearance. If further experience should countenance this view, the remarkable influence exerted by electricity in the treatment of chorea may be referred to the principle of "counter-irritation."

It may be next inquired whether in the treatment of chorea we ought to trust to electricity alone. In answer to this it may be stated that I have repeatedly treated severe cases of this disease successfully with this agent, without the aid of any medicine at all; and in the majority of the thirty-six cases in the table no internal medicine except an occasional purgative was administered during the electrical treatment.

Still it is obvious that in many cases the disease is kept up and excited by the irritation produced by some deranged function, and this of course it will be the duty of the physician to set right before or during the application of the electricity. The case of Eliza Raven affords an interesting illustration of this. Here the chorea either depended upon the non-performance of the uterine function or was kept up by it, and accordingly a few electric shocks through the pelvis at once cured the patient by restoring the deficient menstrual discharge.

CHAPTER IX.

CONTINUATION OF DR. BIRD'S REPORT.

Paralysis. Varieties in which electricity was successful. Table of eleven cases of dropped hands Methods employed in treatment. The necessity of regulating functions Clinical histories of cases of paralysis, with results of treatment by static sparks. Conclusions regarding the value of static electricity in paralysis. Prognosis. Recovery greatly hastened by static electricity. Prognosis in paralysis from mechanical injury Rapid relief of hysterical paralysis by static electricity Clinical cases, with treatment and results.

Paralysis. — Paralytic affections constitute a prominent feature in the cases which have been referred to the electrical room of the hospital. Forty-four cases of these have been fully reported by the clinical clerks and may be found on record in the hospital books. Of these cases it may be generally remarked that those in which the paralysis, whether of sensation or motion, or both, depended on the following causes, the result of the application of electricity was most successful.

1. Exposure to cold.
2. Rheumatism.
3. Some functional affection, often of a local character, or
4. Upon the impression produced by effusion in some part of the cerebro-spinal centre which had become absorbed under the influence of previous treatment.

While in those cases in which the paralysis depended upon some persistent structural lesion, whether produced by accident or otherwise, I never saw the slightest benefit result.

The reported cases of paralysis may be divided into the following classes:

1. Those of dropped hands (lead poison).
2. Those of rheumatic character.

3. Those dependent upon some lesions of the cerebro-spinal centre.

4. Those dependent upon local injury to a limb.

5. Those dependent upon hysteria.

CASES OF DROPPED HANDS.

No.	Name.	Age.	Ill.	Cause.	Result.
1	Maria Mills.....	43	6 weeks.	Sleeping in freshly painted room.	No relief.
2	R. Gardner.....	19	3 weeks.	Handling types.	Cured.
3	C. Manning.....	24	2 years.	Painter by trade.	Cured.
4	J. Shepard.....	37	9 months.	Painter by trade.	Relieved.
5	H. Moffat.....	55	?	Using lead shot in washing bottles.	Relieved.
6	Mary Reudon.....	36	9 months.	Cleaning fresh-painted rooms.	No relief.
7	Geo. Hayward.....	20	?	Painter by trade.	Relieved.
8	C. Backelly.....	29	10 days.	Mixing paint.	Cured.
9	W. Ward.....	36	3 years.	His trade.	Cured.
10	J. Ibbotson.....	27	3 months.	His trade.	Cured.
11	W. Atkinson.....	39	2 months.	His trade.	Improved.

In the treatment of these eleven cases electricity was generally employed in the form of sparks drawn from the upper part of the spine so as to exert its influence over the origin of the spinal nerve forming the axillary plexus. In the majority of cases medical treatment also was employed, as in general the subjects of lead poisoning are always deranged in health, the functions of the digestive organs being imperfectly performed, especially as in most cases the patient has previously been subject to lead colic.

In the cases where the general health was not much deranged, the use of electricity over the spine and a few sparks occasionally on the paralyzed extensor muscles of the wrist and hand, with the exhibition of an occasional laxative, was generally remarkably successful. But in those instances in which the patient was of cachectic habit, and the constitution deranged by previous or existing functional derangement of the digestive organs in particular, electricity was of no service, or at most was of doubtful efficacy until the deranged functions had been relieved by the remedial measures employed.

The following cases will be sufficient to show the effects produced by electricity in this disease when the general health

Rheumatic Paralysis.—Cases of this affection are by no means infrequent in practice, and are readily distinguished on careful investigation from those which depend upon cerebro-spinal lesion. The cases most readily confounded with them are those in which the legs and arms appear paralyzed, but in which the inability to move the limbs depends rather upon the pain produced by motion than upon any real want of power. The common history of these cases is, that a person after exposure to damp and cold and sudden alterations of temperature suffers from a slight febrile attack, followed by inability to move one or other of the limbs, and often a single arm or leg if either of these have been exposed to the influence of a draught or current of air. In general sensation remains either slightly or not at all impaired, but the paralysis of motion is generally tolerably perfect. This state may continue for an almost indefinite period; and at length, from want of exercise, the muscles of the affected limb become atrophied, and the chance of relief from treatment of any kind becomes proportionately diminished. In cases of this kind before this wasting has occurred, the influence of electricity is very remarkable, frequently restoring power to the paralyzed muscles in a very short time.

The following table will serve as an index to the cases of the disease under consideration, reported in the case book of the electrical room:

No.	Name.	Age.	Ill.	Seat of paralysis.	Result.
1	Jas. Young	15		Right arm.	Cured.
2	M. Gregory	41	2 months.	Right arm.	No relief.
3	Richard Eve	32	10 months.	Right arm and both hands.	Cured.
4	Dan Dennis	38	8 months.	Right leg.	Cured.
5	D. Lauriston	45	1 year.	Both legs.	Improved.
6	Dennis Bryan	29	3 months.	Both legs.	No relief.
7	W. Evans	30	9 weeks.		Cured.
8	J. McDermot	50	3 years.		Improved.
9	W. Williamson	48	14 days.	Both legs.	Improved.
10	W. Johnson	28	4 months.	Both legs.	Cured.

Of these it will be sufficient to record the following for the sake of illustrating the class of cases in which electricity appears to exert a sanatory influence.

CASE XIV.—**Paralysis of Motion of Right Arm.**—James Young, aged 15, admitted into hospital in the middle January 1837, under care of Dr. Bright. Sixteen months ago suffered from pain and swelling at the upper part of the neck; this was followed in two months by loss of power over right arm, for which he continued under treatment during nine months without benefit so far as power over the paralyzed limb was concerned. Then it was determined to try electricity, and in the middle of August twelve shocks were ordered to be passed from the region of the cervical vertebræ to the fingers of right hand daily.

October 8th: Has gradually improved and has now considerable power over affected limb.

October 20th: Recovered completely the power of moving the arm, and was discharged cured.

CASE XV.—**Paralysis of Right Arm and Both Hands.**—Richard Eve, aged 32, sailor, admitted September 17th, 1838, under care of Dr. Addison. Ten months previously while on board a trading vessel off the coast of Africa, he became subject of fever for which cold affusions were copiously used, and to this he attributes the paralysis of right forearm and both hands which appeared when convalescing from the disease. On admission he was quite unable to move the paralyzed limbs; general health excellent.

September 27th: Sparks thrice a week from spine and paralyzed muscles.

November 14th: He has improved daily, and being now in possession of full power over the previously paralyzed limbs, he was this day presented cured.

CASE XVI.—**Paralysis of Right Leg following Rheumatism.**—Dan Dennis, aged 38, admitted under Dr. Bright's care. Eight months previously, after exposure to damp and cold, he became affected with rheumatism attacking all his limbs; this under remedial measure became relieved, but he was left destitute of all power over the right leg. The sensation in the limb is tolerable perfect.

July 9th, 1840: Sparks on alternate days from the region of the lumbar vertebræ and down the affected limb.

August 18th: He has gradually regained power over the limb and left to-day—well.

CASE XVII.—**Paralysis of Motion of Both Hands.**—William Evans, aged 30, admitted under care of Dr. Babington. This man was employed loading and unloading cargoes of coast-

ing vessels at one of the wharfs, and a few weeks ago while unpacking salmon the cold water from the melting ice burst from one of the packages and drenched him completely. He took no notice of this, but on the following day the little finger of his right hand became numb; this gradually increased, and in a week he lost all power over both hands, sensation remaining unaffected.

October 19th, 1840: Sparks from the spine and affected hands. Under this treatment he rapidly improved, and after attending a few times, he became so much improved as to be enabled to return to his work.

CASE XVIII.—**Hemiplegia Following a Fall.**—James Harrington, aged 30, an out-patient, under Dr. Hughes, affected with paralysis of sensation and motion of right half of body, which made its appearance nine months previously, almost immediately after a fall, in which he struck his head. The paralysis is but partial, as he can walk, although with considerable difficulty, and when the side is touched he feels as if pressure were applied through a folded cloth.

December 16th, 1837: Electric shocks passed from the spine down the leg and arm twice a week.

April 3d, 1838: He has gradually but slowly improved up to this date, when he was presented cured.

CASE XIX.—**Paraplegia Following a Fit.**—Eliza Perry, aged 26, was, in the spring of 1840, suddenly seized with a fit of an apoplectic character. This lasted two hours and was shortly followed by a second, on recovering which she was found to be the subject of complete paraplegia, having lost all power of motion or sensation in the lower half of the body.

She was admitted into the Dorcas ward under Dr. Allison, and there under treatment improved considerably, and the general health became excellent. In November she was made an out-patient. She could manage to walk about, but with a tottering gait, sensation and motion being as yet imperfect in the affected limbs.

On the 27th of November Dr. Bird directed sparks to be applied over the lumbar vertebræ and sacrum, and down the legs and thighs. Under this treatment she rapidly improved so that in a short time she recovered as complete sensation and motion in the legs as she had ever possessed.

CASE XXI.—**Paralysis of Motion of the Right Half of the Body.**—George Morris, aged 46, has, for the last nine years, been employed as a waiter at an inn, generally enjoying

excellent health. Three months before applying to the hospital he experienced a sudden loss of power in the right arm, together with loss of sensation in the fingers. The paralysis shortly increased, extending down the right side and leg, sensation remaining in these parts perfect. At present (September 22d, 1837) he walks with difficulty, and has total paralysis of the right arm. Loss of sensation is, however, quite limited to the fingers.

September 22d: Ordered twelve shocks to be passed from the spine down the leg and arm on alternate days.

October 31st: Has continued to improve, and has now recovered completely power over the affected side. A benumbed state of one finger of the right hand alone remains, and he has returned to his employment.

CASE XXII.—**Paralysis of Motion of the Right Half of the Body.**—Steven Burn, aged 11, admitted January 15th, 1840, laboring under total loss of motion of the right leg and side, which appeared seven weeks previously, without any apparent cause, while in bed. He has been gradually getting worse, and has been cupped, taken mercury, had his head shaved, etc., without any marked benefit. He was carried from the ward into the electrical room, being quite unable to walk. Sparks were freely drawn from the spine and affected limbs. The effect was remarkable, for the boy almost immediately recovered power over the previously paralyzed side, and he walked back in the ward with only the aid of a stick. After attending a few days longer he was discharged completely well.

CASE XXIII.—**Paralysis of Motion Limited to the Right Arm.**—Henry Tappy, aged 22, employed as a smith, an out-patient. On July 24th, 1840, while in the act of taking money from his pocket was suddenly seized with complete paralysis of the right arm. When he applied at the hospital he was quite unable to use the arm or hand. He had never suffered from rheumatism, had never had any evident cerebral affection, and did not appear to have had any mechanical injury to the limb itself.

August 4th: Sparks were freely taken from the dorsal and cervical regions of the spine and down the arm.

September 1st: Has gradually acquired power over the arm and was discharged quite well.

CASE XXIV.—**Paralysis of Sensation Limited to Right Arm and Side of the Face.**—William Hunter, aged 55, admitted November 29th, 1839, has been employed as a coal-por-

ter and is accustomed to carrying heavy baskets on his right shoulder. The whole of the right side of the face is dull of sensation, and this state of things extends partially down the right arm and hand. Muscular motion is unaffected. There is no evidence of his having suffered from cerebral disease or rheumatism. General health is deranged.

November 29th, treatment: Electric sparks from the spine and from the face and arm.

Hydrarg. cum conio . . . . gr. v., *t.i.d.*

December 24th: Sensation returned in his arm but the face remains unimproved. A current was passed from the faradic apparatus over the face, as closely as possible, in the direction of the larger branches of the fifth pair of nerves.

January 10th, 1840: Has improved almost daily, and although not completely well has returned to his work.

Several cases of paralysis of a single limb, or part of one, from local injury have been treated by static electricity. Of these the following four have been reported in full:

No.	Name.	Age.	Seat of paralysis.	Cause.
1	T. Cunningham.....	50	Left arm.	Falling on the arm.
2	H. Myddleton.....	66	Right arm.	Injury to shoulder.
3	Ann Bouchard.....	26	Ankle joint.	Falling with foot bent.
4	W. —.....	58	Left arm.	Dislocated humerus.

Of these cases it may be briefly observed that in those in which there was evidence of positive structural lesion of one or the other of the nervous trunks supplying the affected limb, no benefit resulted from the application of electricity; while on the other hand, where the nerve had been left only functionally paralyzed, and its structure unaffected, an electric current produced rapid and, in some instances, immediate relief.

Of the four cases inserted in the above table the third and fourth were cases in which there could be but little doubt that the nerve trunks were themselves mechanically injured; in the fourth case in particular, in which a man dislocated his humerus into the axilla from a fall, and it remained unreduced for seven weeks. On his admission into the hospital the dislocation was reduced, but the arm was left in a partially paralyzed state;

the part supplied by the internal cutaneous and median nerves being especially affected. In this case, as might be expected, electricity was found altogether useless, as there was reason to believe that some branches of the axillary plexus had become structurally injured by the pressure to which they had been subjected.

The other two cases are worth recording.

CASE XXV.—**Paralysis of Left Arm from Injury.**—Thomas Cunningham, aged 50, a shoemaker of good general health, on the 6th of June, 1837, while walking up-stairs fell with his left arm bent under him. He almost instantly lost all power of the limb. On recovering from the shock produced by the accident he found himself completely deprived of motion and sensation in any part of the arm. This continued for three weeks, when he applied at the hospital and was sent to the electrical room.

I ordered weak shocks to be passed from the cervical region to the tips of the fingers daily.

June 13th: Sensation and motion have returned to the upper part of the arm; numbness still exists in the forearm.

July 17th: So much improved as to be able to resume his work.

CASE XXVI.—**Partial Paralysis of Right Arm Following a Fall.**—Henry Middleton, aged 60, a strong and muscular man, six weeks prior to his appearance at the hospital fell while walking and struck his right shoulder. Very slight pain followed the accident; but from the time of its occurrence the arm has been partially paralyzed. He is able to imperfectly flex and to completely extend the forearm, but is quite incapable of raising the humerus, so that the chief seat of paralysis appeared to be in the deltoid muscle.

November 12th: Sparks were ordered to be applied daily to the affected shoulder.

December 3d: Under this treatment he considerably improved, and to-day ceased to attend.

In these curious cases of partial paralysis, in which we find the affection limited to a very small portion of a limb, often to a single muscle, I have found the application of electricity of considerable service, although from the rarity of these cases I have not had sufficient experience to allow me to offer anything more than a very general opinion.

The cases here recorded are, I think, sufficient to justify the conclusions I have drawn of the value of electricity as a remedial agent in paralysis, and I have no hesitation in stating my conviction that in the majority of cases a careful investigation into the history of the ailment will enable the practitioner to determine whether electricity will be of service in any particular case.

Every one must be aware of the occurrence of cases in which paralysis, generally affecting one side of the body, comes on as a mere effect of congestion or of effusion, which, under the action of depletion and mercury, can be completely removed, and yet the effect of the morbid action—the paralysis itself—remains. Cases of this kind will generally do well by time, aided by the application of friction, baths, etc., yet convalescence will be extremely protracted.

Here the passage of a few electric shocks through the limbs, so as to arouse, as it were, the dormant functions of the nerves, will at once frequently restore as complete power over the affected limb as the state of the muscles, weakened by previous disorder, will admit of. Of this we have a remarkable example in Case XXII.

When the paralysis has been of longer date, or the cause producing it of a more persistent character, it will be found necessary to continue the application of the electric shocks for a longer period of time.

The truth of the statement here made, of the class of cases of paralysis in which electricity may be employed with every probability of success, is supported by what we see in its employment in the local paralysis following mechanical injury to a limb, for wherever the nerve trunks supplying a limb are lacerated, or otherwise mechanically injured, we can hold out no hope of relief from the application of electricity or any other remedy; while in cases in which, from the shock of the blow applied to the limb, the nerve trunks had been only functionally paralyzed, the structure remaining unaffected, the

passage of the electricity effected a complete restoration of the limb.

In accordance with this reasoning we find that anomalous forms of paralysis connected with hysteria generally yield to the application of a few electric shocks. I have indeed repeatedly seen hysteric paraplegia yield so rapidly to the effect of an electric shock as to strongly impress those who were watching the case with a conviction that the whole disease was simulated. The following two cases will be sufficient to illustrate the foregoing remarks:

CASE XXVII.—**Hysterical Paralysis of the Left Half of the Body Depending upon Amenorrhœa.**—Matilda Simmons, aged 16, a fair, stout girl, with brown eyes, and delicate skin, was born in the country and came to London two years ago. Has lived in service during that time, her general health being pretty good. Since the age of fifteen she has suffered constant and severe pains under the left heart, with frequent palpitations and headache; she first menstruated a year ago and continued regular each time about six days, and always with considerable pain.

About six months before her admission to the hospital she was exposed to cold while menstruating. The discharge was checked and an hysteric fit occurred. This was followed in a fortnight by a second, and from that time to the present she has been ailing. Ten days ago (April 14th, 1837), after an hysteric fit she lost the sight of the left eye. The eyelid dropped and nearly complete paralysis of the left half of the body occurred. She was admitted to the hospital and sent to the electrical room.

April 24: Electric shocks were ordered through the loins and along the spine on alternate days.

May 10: The electricity has been continued regularly, and she is now so free from paralysis that the case is regarded one of simulation. The ptosis, however, remains.

On June 13th she menstruated and shortly afterward was presented cured.

CASE XXIX.—**Hysteric Paralysis of Lower Half of the Body.**—Jane Goulder, aged 15, a florid-looking girl, admitted into hospital October 6th. Six months ago she suffered from what was presumed to be an injury of the ankle, as she appeared to have lost all power over it, but a week later, after an

hysteric attack, she became completely paraplegic, having lost all power of sensation and motion over the lower extremities.

At the time of her admission she had slight return of power, being able to move her toes. She menstruates regularly but with pain.

Shocks were ordered to be passed from the sacrum to the toes daily. October 18th: Nothing remains of the paralysis. She has recovered complete power over the lower extremities and is capable of walking nearly as well as ever. Sensation has completely returned. October 23d: Presented cured.

CHAPTER X.

CONTINUATION OF DR. BIRD'S REPORT.

Amenorrhœa. Necessity of improving the general health. The happy results of static electricity. Rule for insuring success in the great majority of cases. Method of applying an electric shock through the pelvis. Table of twenty-four cases of amenorrhœa. Clinical history of selected cases, with results of treatment. Clinical remarks upon management of treatment. Remarks upon the treatment of chronic rheumatism, sciatica, and lumbago. Epilepsy treated without benefit. Hysterical epilepsy depending upon amenorrhœa successfully treated. Conclusions of Golding Bird.

Amenorrhœa.—Scarcely any cases have been submitted to electrical treatment in which sanatory influence has been so strongly marked as in those in which the menstrual function was deficient. The remarks previously made regarding the electrical treatment of chorea and paralysis alike apply to amenorrhœa, so long as the patient is seriously out of health, as when marked symptoms of chlorosis are present scarcely the slightest benefit has ever resulted from the employment of electricity.

In fact, as this agent can in these cases be regarded as a local stimulant applied to an organ whose function is deficient, we can hardly expect the menstrual discharge to appear when, from the deranged state of the general health, the womb is not in a state to supply the deficient secretion.

The rule for insuring success in the great mass of cases of amenorrhœa is sufficiently simple: Improve the general health by exercise and tonics, remove the accumulations often present in the bowels by appropriate purgatives; and then a few static shocks (often a single one) will be sufficient to produce menstruation, and at once restore the previously deficient function.

It is for want of attending to this rule that so many cases have been said to have been unsuccessfully treated by electricity, and to this statement I must oppose all the experience acquired from the cases treated in the electrical room of Guy's Hospital, for, with but one or two exceptions, every case, in which the general health was not so severely deranged (as by chlorosis), has been successful—of course not including those who, from timidity or other causes, never appeared but once or twice at the hospital.

The mode of applying the "electric shock" is the following: Let the patient be placed on a chair or stool. Press the brass knob of a director against the sacrum, and if the stays be loosened so that only the linen intervenes between the skin and the knob, no exposure is necessary. A second director, furnished with a chain connected with the outside of a Leyden jar, is passed by the female attendant under the patient's dress and the knob pressed against the pubes. The jar is then charged, and its ball touched by a third director connected with the one held against the sacrum by means of a chain. The shock thus passes through the patient's pelvis and should be repeated ten or a dozen times.

The jar employed should hold about a quart and be about half charged.*

The following table contains the names of the patients treated in the electrical room of Guy's Hospital for amenorrhœa whose cases have been reported at length in the report book. In the first four cases inserted in this table, the patients were the subjects of well-marked chlorosis and of an irritable condition of the uterus, shown in the first case by the presence of a thick mucous mischarge from the vagina; and in these, as might have been anticipated, the application of electricity as a

* The reader will remember that Dr. Bird was dealing with a machine of about one-tenth the power of our high-grade largest Holtz machines of the present day, and no such application as is described above would be attempted now. Properly directed spark applications will now accomplish the results which in the days of the feebler machines required the Leyden-jar discharges.

direct stimulant to an anæmic and irritable organ was utterly useless, while in the remaining twenty cases in which no preternatural irritability of the womb existed, and where the depraved state of the general health termed chlorosis was either absent altogether or but slightly manifested, the influence of the electric treatment was very remarkable.

CASES OF AMENORRHŒA.

No.	Name.	Age.	Ill,	State of general health.	Result.
1	M. Williams	15	Never menstruated.	Chlorotic.	No relief.
2	Mary Evans	17	3 months.	Chlorotic.	No relief.
3	M. Crighton	16	Never menstruated.	Chlorotic.	No relief.
4	Mary Dawes	14	Never menstruated.	Chlorotic.	No relief.
5	Har. Ibrock	16	?	Slightly chlorotic.	Cured.
6	S. Bunday	16	10 months.	Not chlorotic.	"
7	E. Boldock	18	3 months	Not chlorotic.	"
8	A. McGauvin	18	1 year.	Not chlorotic.	"
9	S. Green	21	3 years.	Slightly chlorotic.	"
10	Emma Laard	19	5 months.	Hysteric.	"
11	M. Burgess	19	1 year.	Slightly chlorotic.	"
12	Car. Watts	17	5 weeks.	Not chlorotic.	"
13	E. Maston	16	Never menstruated.	Slightly chlorotic.	"
14	S. Burrow	19	2 months.	No chlorosis.	"
15	S. Parker	16	8 months.	No chlorosis.	"
16	M. Winman	19	6 months.	Slight chlorosis.	"
17	Betsy Ryan	17	10 months.	Slight chlorosis.	"
18	S. Glasscock	25	8 weeks.	No chlorosis.	"
19	M. Freeburn	16	8 months.	No chlorosis.	"
20	M. Mitchell	16	6 months.	No chlorosis.	"
21	E. Mind	16	6 months.	No chlorosis.	"
22	E. Cathrie	20	?	Hysteric.	"
23	N. Boulchin	17	3 months.	No chlorosis.	"
24	E. Boyce	24	2 months.	No chlorosis.	"

It will be sufficient to relate a few of the above table as in general they very closely resemble each other in the progress.

CASE XXX.—**Amenorrhœa Lasting Eight Months.**—Sarah Parker, aged 16, a pallid girl of good general health. An outpatient. First menstruated about nine months ago and caught cold during the menstrual period. Has had no return during eight months. After prescribing a few purgatives she was ordered a dozen shocks through the pelvis and on the following morning the catamenia appeared. The discharge lasted four days, at the end of which time she felt perfectly well.

CASE XXXI.—**Amenorrhœa Lasting Three Years.**—Sarah Green, aged 21, has not menstruated for three years except a light appearance three days ago. She has taken chalybeates, with improvement to her general health. A dozen shocks were ordered through the uterus and a copious flow of the menstrual

discharge soon followed and continued four days. She shortly after left the hospital quite well.

CASE XXXII.—**Amenorrhœa Lasting Three Months.**—Betsy Ryan, aged 17, a rather chlorotic-looking servant-girl, first menstruated at the age of fifteen. Continued regular for a year, when the catamenia entirely ceased. She had a slight appearance three months ago, and since then nothing. She was ordered: Julep ammonia et tinct. lyttæ., minims x. t.i.d., and shocks were ordered daily through the pelvis. On the evening of the third day the menstrual discharge appeared and continued flowing four days.

CASE XXXIII.—**Amenorrhœa.**—Caroline Watts, aged 18 (January 13th, 1840), a healthy-looking girl of sedentary habits. First menstruated at 14, but discharge has always been irregular and occasionally absent for an entire year. A slight return occurred five weeks ago, attended with severe pleurodynia, under which she still labors. Bowels constipated. Ordered: Pulv. aloes comp. and shocks through the pelvis thrice a week.

January 13th: Catamenia appeared to-day and continued for two days—stop electricity for a fortnight.

February 4th: Electricity commenced again. Menstruation occurred freely on the 14th.

CASE XXXIV.—**Amenorrhœa.**—Sarah Burrow, aged 19, a healthy-looking girl of sedentary habits. First menstruated at 14, was last unwell two months ago. Has been at the dispensary for a month, during which time her bowels, naturally costive, have been regulated by an aloetic purgative.

January 31st: Shocks through the pelvis thrice a week.

February 10th: Menstruated copiously to-day. Electricity stopped for a fortnight, at the end of which time it was resumed and the discharge again appeared at the proper period.

In general, whenever the menstrual discharge has appeared under the influence of the electric treatment I have directed the remedy to be intermitted as soon as the flow has been fairly established, and its use to be recommenced about a week before its expected return as in Cases XXXIII. and XXXIV.

Whenever, as has occasionally occurred, the use of electricity has been persisted in during four or five weeks without benefit, I generally advise stopping it altogether and by a careful investigation of the case ascertain as far as possible the cause of

the deranged general health (which always, as far as I have seen, exists in these unsuccessful cases), and after removing this by remedies, the use of electricity will then seldom fail to restore the catamenia and thus effect the cure of the patient.

With regard to other diseases in which static electricity has been used, the results have not been sufficiently uniform to warrant any trustworthy conclusion to be drawn.

In amaurosis especially the results of the trials were too conflicting to be satisfactory. In the majority of instances it certainly did no good, in a very few it appeared to afford some relief, but in none did it effect anything like a cure. In various cases of deafness the results of electricity was similar.

In chronic rheumatism, especially in sciatica and lumbago, a considerable alleviation of suffering was frequently effected by drawing sparks from the seat of pain, but the cases submitted to treatment have not as yet been sufficiently numerous to warrant any general conclusions.

Much has been said regarding the reputed efficacy of electricity in the treatment of ovarian dropsy. I can only state that in the cases of this disease admitted to the electrical room of Guy's Hospital not the slightest appearance of absorption of fluid was ever observed.

A great number of cases of epilepsy have been treated by drawing sparks from the spine, but in no instance with any benefit. In fact, from the results at Guy's Hospital I feel warranted in stating that electricity has never been of the slightest service in the treatment of convulsive affections in which the brain was involved, as in epilepsy, while, as already stated, in chorea, in which the brain is generally unaffected, the result of static electricity was most gratifying.

In hysteric epilepsy occurring in women in whom the uterine functions were suspended, electricity by restoring the catamenia was of material service.

These can, however, scarcely be regarded as cases of genuine epilepsy, but rather of an hysteric convulsion depending upon

the non-performance of the uterine functions. Several cases of this description have occurred at the hospital, of which it will be sufficient to mention one as an example of the rest:

CASE XXXV.—**Hysteric Epilepsy Depending upon Amenorrhœa.**—Sarah Watson, aged 15, a stout girl of remarkably dull appearance, states that six months before coming to the hospital she was in tolerably good health. At that time, however, she became subject to fits of an epileptiform character.

These occurred at irregular intervals and lasted each time about fifteen or twenty minutes. Has never menstruated, and she labors under the nervous feelings and headache so frequent in amenorrhœa.

October 10th, 1839: Ordered shock through pelvis thrice a week.

October 13th, 1839: The shocks were passed to-day for the second time only, and in a short time were followed by pains in the back and loins—soon afterward the menstrual flow appeared.

October 14th: Catamenia still flowing.

From this time she remained free from fits.

In the remarks contained in this paper and from the cases detailed I venture to hope that I have adduced a sufficient amount of evidence to demonstrate that static electricity, though possessing no specific or magic influence over any particular diseases, is yet really capable, when judiciously applied, of producing marked effects, and although it fails to produce the wonderful results ascribed to it by empirics, is nevertheless capable of becoming an important aid in the treatment of diseases.

CHAPTER XI.

THE GUY'S HOSPITAL REPORTS OF HUGHES AND GULL.

Digest of one hundred cases of chorea, by H. M. Hughes, M.D., Guy's Hospital, London, England, 1846. A further report of the value of static electricity by Sir William Gull, M.D., D.C.L., F.R.S., 1853. Discussion of the question: "How does static electricity act?" Hemiplegia and paraplegia. Curable and incurable cases. Clinical histories and results of treatment. Remarkable results in cases of paralysis due to cold. Facial paralysis. Table of cases. Clinical histories and results of treatment. Paralysis from the use of a crutch. Paralysis resulting from pressure during sleep. Static electricity a certain and rapid remedy. Clinical cases with results of treatment. Paralysis from lead. Action of static electricity after elimination of the lead. Table of cases. Clinical histories with results of treatment.

Chorea.—Much has already been written in these reports of the effect of this remedy in chorea and other spasmodic affections. My observations will therefore be brief.

The effects of electricity in chorea are sometimes very remarkable. On some occasions I have known it to effect a cure after a great variety of other remedies had for weeks and months been tried in vain.

When the body has been wasting, the mind apparently giving way, and the disease proceeding unchecked if not increasing, notwithstanding a variety of remedies employed assiduously and for a long time, electricity has under my own observation and direction effected a really marvellous change. This change has not been more beneficial than it has been rapid.

In the course of a week or ten days the entire aspect of the patient has been changed. The motions of the extremities

have been reduced to the control of the will; the body has become comparatively robust, and the face plump; the countenance has not its vacant expression; the disease has in fact been cured, and the effects of the disease upon the health and appearance have ceased.

When electricity acts beneficially in chorea it produces its effects more rapidly than any other remedy with which I am acquainted, but it is a remedy which is not of universal application in chorea. In some cases it has obviously done harm. In weak, nervous, timid children electricity often increases the disease.*

The cases in which it appears to be more especially applicable are those occurring in young women, in whom the disease assumes somewhat of an hysterical character, and those protracted cases in boys in whom the other remedies have been tried uneffectively, and in whom the disease is dependent upon no obvious source of irritation and has an injurious effect upon the general health instead of being affected by it.

Electricity is (in the table) stated to have been employed in only fourteen cases. Several of them were of the most severe form and of considerable duration. It effected a cure in nine and failed in five. Of the successful cases it was used in combination with zinc in five and with iron in one case.

H. M. HUGHES.

* This probably arose from the alarm caused the patient by the manner of the treatment. If the confidence of the child is first won and the treatment explained and administered gradually with the full consent of the timid patient, there will be few failures from this cause.

Routine methods in dispensaries, however, are not always adapted to individual cases, and in private practice, and with judicious tact in dealing with children or others who may be the victim of nervous conditions, there need be no hesitation in advising static electricity.

A skilful operator will never do harm with it, in any case; and if it occasionally fails to be the chief means of cure it will nearly always render important auxiliary assistance.—AUTHOR.

A FURTHER REPORT ON THE VALUE OF ELECTRICITY AS A REMEDIAL AGENT.

BY SIR WILLIAM GULL, M.D., D.C.L., F.R.S., GUY'S HOSPITAL, 1853.

The cases continued in the following report are taken from the books of the electricity room of Guy's Hospital under my own inspection. They would have been more numerous had we been able to enforce upon our patients a more regular attendance, but after having carefully recorded the details of their history, progress, and present state, our labor has, in more than one-half the cases, been lost by their non-attendance, or by their attending so irregularly, or for so short a time, as that no practical inference could be drawn.

We have at present no evidence of any especial relation between the *vis nervosa* and the electrical forces, and from the sources of electricity in the treatment of the various forms of nervous diseases we cannot in the present state of our knowledge infer that such beneficial results depend upon any essential similarity between that force which expresses itself in the nervous system, and the forces of electricity.

It is more probable that electricity here acts as any other mechanical stimulus, but with this peculiarity, that it more intimately affects the whole molecular structure of the part it stimulates, without leaving any permanent derangement. Admitting, therefore, that the electrical stimulus calls out the energy of a part and excites its function, yet it produces its good results in various ways, and it is in considering these that we may most practically answer the question, "How does static electricity act?"

Thus in paralysis electricity acts by stimulating the functions of the nerves and muscles, and as nutrition bears a direct relation to activity of function, we are thus enabled to prevent the wasting which so rapidly follows when a part is quiescent.

If we exclude the effects of mental emotion, so readily ex-

cited in hysterical subjects by any form of manipulation, we may probably refer the beneficial action of electricity in hysteria to the impression it produces upon the *sensitive nerves*, since such subjects are often equally benefited by many other modes of excitement.

The remarkable and in some instances astonishing results obtained by electricity in chorea would seem to warrant the assumption of some direct controlling power in the electrical force over the nervous centres, but these are probably in part applicable to the *known* action of this stimulus upon the tissues.

Dr. Bird in his report upon the subject refers them to the counter-irritation produced upon the skin, but I am rather disposed to believe that the good effects are the result of a direct stimulus to the blood-vessels of the nerve centres, producing a more tonic and vigorous circulation in them.

If such be its action—and there seems no reason to doubt that *internal* capillaries are affected as *external* ones are, though in a less degree—then the action of electricity in chorea is not altogether different from that of the mineral tonics administered as successfully in this disease, circulating as they do to the ultimate capillaries and producing a tonic state of their walls, as well as acting in other ways. Nor should we leave out of consideration the effects of the excitement upon the nerve tissue itself, although, in the present state of our knowledge, we are unable to explain why it should be beneficial.

Hemiplegia and Paraplegia.—I do not include in the report the numerous cases of hemiplegia and paraplegia depending upon organic diseases of the nerve centres, such as effusion of blood, ramollissement, tumors, and the like, since electricity holds but a subordinate place in their treatment. Time with its slow workings to recovery is chiefly to be relied on.

Electricity is not, however, altogether useless even here, for when the cause of the paralysis is removed, or in process of removal, it is often of service during the convalescence, not only by the direct stimulus it affords to the long quiescent

nerves and muscles, but also by its tonic influence over the vascular trunks, as well as by facilitating the venous circulation by the passive motion it excites in the muscles.

It is in hemiplegia and paraplegia depending upon the direct influence of cold, or arising from atony and hysteria, that electricity is of the greatest value. *In these cases it is inestimable.* I regret that I am not able to present the details of many cases, which in their general outlines so vividly present themselves to my mind as illustrations of the good to be gained by this means. The following, therefore, must suffice:

CASE II.—**Paraplegia from Cold.**—W. E——, aged 51, a laborer residing at Craydon. Twelve months since he was occupied in delving and exposed much to cold and damp. He then began to suffer from a feeling of numbness and coldness extending upward from the toes to the middle of the thighs, with a sense of tightness around the lower part of the abdomen and complete loss of power over the legs. This state of things continued for eight months.

During the last four months the sensibility has been slowly returning, and is now in a great measure recovered. With this he has regained a slight degree of power over the muscles of the left foot, which he is able to flex when the leg is immersed in warm water. The right leg remains unimproved. Since he has been paralytic he has been subject to slight giddiness and painful tingling in the tips of the fingers.

On May 25th, he began to have sparks of electricity taken from the whole length of the spine and especially from the lumbar segments and from the legs. This treatment was continued till the end of July, when he was so considerably improved that he ceased to attend.

CASE III.—**Cervical Paraplegia from Exposure to Cold.**—J. N——, aged 42, a countryman, carpenter, in good health, but disposed to drink, says his present illness came on nine weeks ago. He had been working in the rain the whole preceding day, the weather being at the time cold. He allowed his clothes to dry on him, and went to bed in his usual health, but on waking the following morning he was nearly helpless and continued to get more so for a week, but never had any pain or swelling in the joints.

At present the whole muscular system is flaccid and wasted.

He does not complain of any want of power in his legs, his principal weakness being in his arms and shoulders. There is no pain in the head, the memory is clear, the face intelligent, senses perfect, slight numbness in left foot and across the fingers of the right hand. No tenderness in any part of the spine. No evidence of any infection from lead either from the history or from the gums.

September 15th: Ordered static sparks from the spine generally and from the arms in particular.

October 1st: Complains of pain in the middle of the cervical region shooting across to the shoulders.

This was entirely removed by a blister.

October 26th: Much improved. He can now get his hand to his head.

November 19th: Beginning to use the arms with tolerable facility.

At the beginning of December he was convalescing rapidly and went into the country.

CASE IV.—**Dropped Hands and Weakness of Ankles, Probably from Sudden Exposure to Cold.**—G. N——, aged 15, a rather delicate youth, of spare frame, light hair and eyes, came under treatment for dropped hands and weakness of ankles. He says was in good health until the commencement of his present ailment, which came on after getting up in the night and walking barefooted across a paved yard. He found no immediate ill effects, but on the third day he had pain in the knee and cramps in the hands and feet, but no rheumatic swelling of any joints. The hands gradually dropped, and the ankles became so weak that he could not support himself on them. There is no affection of sensation in either the hands or feet. The muscles generally are thin and flabby, but particularly the flexors and extensors of the forearm and legs. There is great wasting of the balls of both thumbs, and of the interossei and also at the plantar muscles. No evidence or history of affection from lead.

Sparks of electricity were drawn from the whole length of the spine and the course of the principal nerves.

He continued the treatment from the beginning of May to the end of July. The improvement from the commencement of the treatment was gradual and decided. When he left off attending he was able to use his hands and walk with steadiness.

CASE V.—**Hemiplegic Weakness and Atrophy of Muscles from Cold** (poor result).—The following case of hemiplegia

probably arose from the direct influence of cold on the left side of the body, and belongs to the same category as facial paralysis from the same cause.

Electricity though continued for many weeks failed to cure the disease, although the improvement was decided.

A. O——, aged 43, a respectable woman, has never suffered from any cerebral symptoms whatever; general health good, employed as a cook in a private family. For the last two years she has felt a gradually increasing weakness and coldness in the left shoulder-joint and in the arms generally. The leg on this side has been similarly affected but not to the same extent.

There is now marked atrophy of the muscles of the shoulder, of the triceps, and of the extensors of the wrist. The muscles of the leg are flabby and somewhat wasted, but not to the same extent as those of the arm. There has never been pain or any affection of sensation, but the whole side is remarkably sensitive to atmospheric changes, the power over the muscles varying with the coldness and dampness of the weather.

The preponderating weakness and marked atrophy of the muscles of the shoulder and of the extensors of the forearm, together with the general history of the case, were sufficient to distinguish it from ordinary hemiplegia arising from disease of the brain, and pointed to some cause affecting directly the nervous expansions and muscles of the affected side. This cause was probably cold, as upon inquiry it appeared that the kitchen opened upon the river, and that when at work or sitting by the fire, it so often happened that every draught of cold air blew upon the left side, which she could not avoid, although in the cold and damp days of winter she suffered much from it.

Sparks were drawn from the affected limbs and from the spine on alternate days for nearly five months, from February 3d to July, 1851. Some slight but decided improvement was visible in the state of the muscles and when the arm was warm she could move it more freely. Still the good effects were not such as to encourage her to persevere for a longer time, and being anxious to go to Wales she ceased attending.

Case VI.—**Dropped Hands from Cold.**—Mr. W——, aged 29, a veterinary surgeon, a strong, well-looking gentleman, gives the following history: Thirteen months ago in a long ride on horseback in the rain, the weather being cold at the time and the wind northeast, his hands were much exposed, and on the following day he observed a distinct weakness in both wrists. There was not at the time nor has there since

been any rheumatic affection of any joint in the body, nor any impairment of the general health.

The weakness now amounts to complete dropping of both wrists, so that he is quite unable to use the hands even to convey food to his mouth, and the extensor muscles are remarkably atrophied. Sensation is not affected. There is some amount of swelling and induration on the backs of the hands, due probably to the blisters which have been applied and also to their depending position. No trace or history of lead poisoning.

He persevered in the use of frictional electricity for several weeks, but finding no benefit, and living at an inconvenient distance from the hospital, he obtained an electro-magnetic apparatus which he employed daily, but at the end of some months, in spite of his energetic perseverance the hands were completely powerless and the extensor muscles atrophied.

Local Paralysis.—Paralysis of a local kind is very apt to occur in certain parts of the body, from the position of the nerves rendering them susceptible to deranging causes. A great variety of these affections are met among the attendants at the electricity room, and in none are the good effects of electricity more marked.

At the head of this class stands facial paralysis. Not only on account of its frequency but also on account of the formidable character it presents, arresting as it does the attention of all the beholders, and often causing more anxiety to friends and medical attendants than the condition which lead to it deserves.

The anatomical relations of the facial nerve, as pointed out by Sir Charles Bell, render it susceptible through its whole course and distribution to a variety of disturbing causes, and hence, as is well known, by far the largest number of cases of facial paralysis depend upon disease of the nerve itself, for it is rare indeed that affections of the brain or medulla oblongata can be so limited as to implicate the roots of this nerve only. Electricity is in these cases often of the greatest service as enabling us to keep up the activity and nutrition of the muscles during the temporary affection of the nerve.

TABLE OF CASES.

Name and sex.	Age.	Cause of paralysis.	Duration of treatment by electricity.	Result.
E. L., female.	6½	Partial paralysis of face on left side, with slight deafness following otorhœa.	Sparks over course of seventh nerve and about ear on alternate days from February 10th to April 4th (8 weeks).	Hearing recovered; only faint trace of paralysis remains.
A. H., female.	12	Draught of cold air on face a week ago; paralysis of left side of face came on gradually.	Nine weeks (from April 1st to May 27th).	Cheek still notably fallen when she left, she can close the eye
W. N., male.	30	Six weeks ago draught of cold air on face; pain during the night; paralysis of right side of face discovered on getting up in the morning.	Five weeks (from February 27th to April 7th).	Cured.
W. C., male.	28	Probably cold; pain in the night about the ears; paralysis of right side discovered following morning; 3 weeks ago.	Six months (from October to April).	Cured.
W. G., male.	31	Paralysis of fifth, seventh and auditory nerves of left side from fracture of the bone of the skull; 3 months ago.	Eleven weeks (October 27th to January 7th).	Hearing recovered; face but little fallen; taste not improved.
M. A. G., female.	9	Paralysis of right side of face; came on within 3 hours after a fright; 2 months ago.	Treated 1 week by galvanism and for 2 weeks by sparks.	Cured.
H. H., male.	34	Probably from cold; paralysis discovered on getting up in the morning; 2 months ago.	Five weeks (April 29th to beginning of June).	Only slight traces of paralysis remain.
N. T., male.	27	Exposure to draught and cold air a fortnight ago, followed by pain about the ear; paralysis of right side of face after 2 days.	Sparks drawn from the affected parts on alternate days from November until April. The attendance was often interrupted.	Traces of paralysis still remaining.
T. H., male.	47	Fall from a cab 5 months ago. Complete facial paralysis and deafness on left side, with paralysis of third division of fifth nerve	Four months (from December to April).	Considerable improvement; could nearly close the eye when he ceased to attend.
R. K., male.	55	Pain about left side of face and ear at various times for several months; paralysis of face discovered one morning on getting up; 17 weeks ago; deafness on same side.	Four and a half months (from December to middle of April).	Facial paralysis removed; deafness remained.

CASE VII.—**Facial Paralysis from a Coup de Vent.**—W. T——, aged 27, a gentleman of rather weak constitution, was in his usual health until three days before I was called to see him. He was then under some alarm on account of paralysis of the right side of his face. Although he took no notice of the circumstance at the time, he informed me on inquiry that three evenings before he had stood talking at the door for a few minutes with some one while the cold air was blowing upon him. The following morning he had pain in the ear with a feeling of stiffness in the cheek, and the next day it had completely fallen. His health was as unusal and he had no other symptoms.

As there was pain about the exit of the seventh nerve, Dr. Lodge of Peckham, who called me to see the case, applied

two leeches and a blister with other appropriate treatment. It only remained for me, therefore, to advise electricity to the cheek. This was first employed on the 20th of October, and it was not until the middle of December that marked signs of improvement followed. On January 31st, the following report was taken from the ward book: "The angle of the mouth can now be moved with tolerable freedom. The branches of the orbital nerve are still completely paralyzed."

The electricity was persevered in, and about the beginning of April our patient was in some dismay, thinking, as he said, that the electricity was doing too much, since the face, instead of being drawn over to the right side as it had been, had now begun gradually to be drawn too much to the left.

The cause of this was obvious. The zygomatic and levator anguli muscles of the paralyzed side had recovered more rapidly than their antagonist, the orbicularis oris, and hence the face was now drawn too much on this side.

By directing the stimulus of the electricity to the paralyzed half of the orbicularis its power slowly increased and the deformity lessened, although traces of the want of balance are still obvious when the patient laughs. In other respects the recovery has been nearly complete, the treatment having been persisted in (with some intermission) for six months.

CASE VIII.—**Facial Paralysis and Loss of Taste on the Same Side, Probably From a Coup de Vent.**—February 27th, 1852: W. N——, aged 30, porter in a banking house and enjoying good health. Six weeks ago on getting up in the morning, found his mouth drawn to the left side and could not close his right eye. At the same time had entirely lost taste on that side of the tongue, *except at the base.* He has since had frequent and severe pain behind the right ear, extending up the side of the head, and to the forehead.

He was very well at the time of the attack and thinks it was caused by exposure to a draught of cold air the day previous. He has been leeched and blistered without benefit. Sparks were ordered on alternate days on the affected parts.

April 17th: He has gradually improved, only very slight traces of paralysis remaining. The taste has quite returned but there is still some numbness in the side of the tongue.

He was after a short time presented well.

CASE IX.—**Facial Paralysis with Loss of Taste on the Same Side, from Cold.**—April 29th, 1851: H. H——, aged 34, stationer, a delicate-looking young man. Has always led

a regular life, and had good health until two months ago, when paralysis of the right side of his face came on abruptly. It appears, after much questioning, that the night before he was taken ill he went out to see a fire and stood on the corner of the street looking at it for some time. He returned home and went to bed without perceiving any ill consequence, but the following morning, when he awoke, he found he could not make the slightest movement with the right side of his face, nor close the right eye, nor taste with the right side of his tongue. There was also pain running up behind the ear and slight deafness.

He has since recovered his taste and hearing, but the facial paralysis remains.

Ordered sparks of electricity to be drawn from the face three times a week.

As the paralysis lessened under the stimulus of electricity I observed a drawing of the face to the opposite side as in Case VII., and from the same cause, the greater recovery of tone in the zygomatics and levator anguli than in the corresponding half of the orbicularis; hence it is stated in the ward book: "He can lift up the angle of the mouth but cannot whistle."

At the beginning of June he discontinued the electricity, only slight traces of paralysis remaining.

CASE X.—**Facial Paralysis and Impairment of Taste, Smell, and Hearing on the Same Side; the Result of Fracture of the Skull.**—W. G——, aged 31, admitted to hospital July, 1849, with injury to the base of skull from some timber falling on his head. There was a discharge of watery fluid and blood from both ears, and after a short time complete paralysis of the left side of the face with loss of smell, taste, and hearing on the same side.

He speedily recovered from the direct effects of the injury and left the hospital. Subsequently the use of electricity was advised. The face was still paralyzed, and the smell, taste, and hearing were almost as much impaired as they were immediately after the injury.

On November 21st the following report was made: "Some time after the injury he could not hear the ticking of a watch with left ear, but he now hears it pretty well.

"The face is less drawn to the right side.

"There is no improvement in the taste and the left pupil is smaller than the right."

December 18th: Can now hear with one ear nearly as well

as the other. Has almost entirely regained his sense of smell. No improvement in the taste. Face still fallen.

January 7th: Has now considerable power over the muscles of expression on the affected side, and the angle of the mouth is but slightly fallen. Taste no better. In this state he discontinued the electricity, having attended more than two months and derived great benefit.

CASE XI.—**Facial Paralysis from Fright.**—W. A. G——, aged 9, a stout yet delicate girl, has never had any illness except measles and weak eyes. On the 15th of October last (two months ago) she was frightened by a drunken man falling down in her father's shop. About two hours afterward her mother came home and observed that she could not close her right eye, and that the face was drawn over to the left side. She had then quite recovered from the fright and was apparently well.

Such were the particulars given by the mother.

The treatment consisted of ferruginous tonics and alteratives. On the 7th of December the face was galvanized and after a week there being no improvement, sparks of electricity were ordered instead. From this time she quickly improved and in a fortnight was able to close the affected eye completely.

Presented well at the end of three weeks.

CASE XII. **Paralysis from the Use of a Crutch.**—C. B——, aged 43, had a fracture of the right leg, which went on favorably and he was soon able to leave his bed and to walk about with a crutch. After a few days the right arm, upon which he supported himself, became weak. His power over the movements of the shoulder was unimpaired. He could flex the elbow but not extend it. The hand dropped at the wrist and there was great weakness of the flexors of the fingers.

The triceps and the muscles of the forearm and hand are very much wasted. Sensation is everywhere perfect except a slight deadness at the tips of the fingers, so that the impression of a hair passed over the skin could be perceivable.

He came first to the electricity room on November 12th and sparks were taken from the course of the affected nerves. The report runs as follows: November 18th, improving.

December 11th: Motions of the arm nearly perfect, but the muscles still wasted.

January 6th: Quite well. The muscles have grown so as to equal or even *surpass* those of the opposite side, and the ball of the thumb stands out firm and bold.

Beyond the interest that attaches to these cases [illegible]e de-

cided advantages gained by the use of electricity, they illustrate the close dependence of muscular growth upon muscular activity. And it may also be considered worthy to note that although in the mixed nerves both the sensitive and motor divisions must equally suffer from the pressure, yet the results to the two functions are very different.

CASE XIII.—**Dropping of the Hand and Paralytic Weakness of the Arm, Coming on During Sleep from Pressure on the Brachial Nerves.**—This is a common accident, and from the circumstances under which it occurs it may, on a cursory investigation, be referred to some affection of the brain and lead to active treatment.

This is not a mere probability, since I have known physicians of great reputation to fall into this error. It may, however, be avoided by a critical inquiry into the character of the paralysis.

An arm paralyzed in hemiplegia from disease of the brain to the extent met with in this accident could not occur without some other sign of hemiplegic weakness on the same side. Again the wrist is far more paralyzed in such a case than corresponds to the weakness of the other muscles of the extremity.

This accident may also be referred to the poisonous action of lead, but that could be distinguished by the history and the absence of the blue lines on the gums.

Moreover, it rarely if ever singles out one hand to the extent seen in these cases and leaves the other unaffected.

Electricity is all the treatment required, as the recovery by its use is certain and rapid.

CASE XIV.—W. P——, aged 21, a stout, healthy young man, given to drink freely, employed at a public house in Camberwell. Went to bed in his usual health and the following morning found his right arm and hand paralyzed. He had no symptoms of disorder of the brain, and was, with the exception of this accident of his arm, in good health.

I was requested to see him by his medical attendant to determine whether the paralysis arose from disease of the brain or from the effects of lead, which he might have imbibed in handling his pewter pots. Both of these causes were negatived on inquiry and the paralysis was referred to pressure on the axillary nerves during sleep. The only treatment employed was sparks of electricity taken in the course of the affected muscles and nerves. It was begun on the 27th of November.

On December 11th, after having the sparks on seven different occasions, he was much improved and after ten applications was quite cured.

CASE XV.—**Paralysis of the Flexors of the Right Arm, Caused by Pressure on the Nerves During Sleep.**—W. P——, aged 30, an iron-safe maker, bilious looking, but enjoying good health. Six weeks ago, on awaking in the morning, he found the flexors of his fingers of the right hand completely paralyzed and the right arm generally weak.

He was otherwise quite well and has remained so, but the hand continues useless. He has had no symptoms of cerebral or spinal affections and attributes the paralysis to lying on the arm during sleep.

On March 14th sparks of electricity were ordered to be drawn in the course of the median nerve of the affected arm.

On the 16th he was reported to be much improved, being able to flex the fingers half-way to the palm.

March 27th: He has attended regularly and to-day comes for the last time. He can now use the arm as well as ever.

CASE XVI.—**Dropping of the Right Hand from Local Pressure on the Wrist During Sleep.**—April 30th, 1852: W. C——, aged 26. Five months ago he went to sleep in his chair in the evening with his hand carelessly placed under his head. He slept for about one hour and a half and awoke to find his hand benumbed and dropped at the wrist with slight adduction. He is unable now, five weeks after the accident, to extend the fingers. There is some tenderness in the course of the nerves, but no want of feeling. His general health is quite good.

Ordered sparks of electricity to be drawn in the course of the nerves and muscles on the back of the hand.

May 15th: Much improved.

May 22d: Presented well.

Eleven cases of this nature are recorded in the books. In two it is not stated which arm was affected. In the other nine cases it was the right. This might have been expected from the natural tendency there is to turn the body to the right side in sleep. The history of these cases is so similar, as are the advantages to be gained from electricity, that it is unnecessary to multiply illustrations.

There are, however, several other forms of local paralysis from accidental pressure which may here be usefully recorded.

CASE XVII.—**Paralytic Weakness of Left Ankle-Joint, Probably from Pressure on the Great Sciatic Nerve by Sitting on the Edge of a Chair.**—July 7th, 1850: E. W——, aged 23, a strong and healthy young carpenter, says that eight weeks ago on Sunday evening he was sitting in a chair gossiping with a friend and on getting up from his seat his left leg was benumbed.

This general affection soon passed off except in the foot as high as a circular line about an inch and a half above the ankle, where there is still a numbness, and the extensor and flexor muscles of the joint are so far paralyzed that he cannot raise the toes from the ground while the heel remains down, and when the foot is raised he can only slightly extend it at the ankle, but cannot support himself on it.

Slight shocks were ordered to be passed through the leg and foot. This treatment was repeated on alternate days, and after attending a few times the muscles so far recovered that he could move the foot in any direction and the sensation was much improved.

Presented cured.

CASE XVIII.—**Paralysis of the Arm from Affection of the Axillary Nerves. Cause Doubtful.**—January 23d, 1850: C. B——, male, aged 32, a dark, robust, married man having led very quiet life, always enjoyed good health until about three months ago when one morning on awaking he felt a severe pain through the axilla and up the side of the neck. He had at the time a severe cold, to which he attributed the pain and loss of power in the arm. Sensation is everywhere perfect except in the index finger. The whole arm has been from the first painful, and although he has never entirely lost the use of it, it is with difficulty he can raise it half as high as his head. His sight, hearing, and functions of his nervous system are perfect and his secretions and excretions normal.

Ordered sparks of electricity to be drawn from the cervical portion of the cord and from the affected arm.

February 3d: Attends regularly and is improved.

February 20th: To-day he comes for the last time, being quite well.

CASE XIX.—**Paralytic Weakness of the Flexors of the Knee and Ankle; Probably from Pressure on the Sciatic**

Nerve.—February 18th, 1852: H. C—— aged 42, a strong, muscular, sober man. Ten months ago, on getting up in the morning, he found he was unable to stand on the left leg, which was weak and numb. The numbness soon passed off but the weakness remained. For this he was treated at University College Hospital for upward of six months, first as an out-patient and afterward in the house. During this time he was cupped and blistered on the back and the blistered surface was kept open for a long period. The leg was also galvanized for eight or nine weeks. Under this treatment he got no better and still continues without relief.

At present he can bear his weight on the left leg, but in walking he drags it after him, from his inability to use the muscles on the posterior part, viz., the flexors of the knee and gastrocnemii. There is no difference in the size of the two limbs, both of which are very muscular and sensation is entire in both. He never had a fit or any other nervous affection nor any injury to the back, or tenderness of the spine, or in the course of the sciatic nerve. He can assign no cause for the attack. He is a temperate man and had not been drinking the night before.

The whole course of the nerve to its junction with the spine has been again and again carefully examined, yet no sign of disease can be detected, nor indeed is it possible for any great amount of disease to exist, since there would have been more decided paralysis and affection of sensation, and the muscles would have in some degree wasted, which they have not. In accordance with my experience in similar cases I could not but suspect that there had been some unlucky pressure upon the nerve during sleep and by it the nerve had been permanently injured. This supposition accords with the history of the attack, coming on as it did during sleep, without any other symptom of nervous affection and being attended with transient numbness.

I think the vascular supply of the sciatic nerve must not be overlooked in considering the effects of pressure upon it.

The patient was treated locally by sparks of electricity drawn from the back of the leg in the course of the large nerves. The treatment was interrupted for some weeks by the occurrence of a severe bronchitis, and also by the ill effects of the blister applied to the knee, which was followed by inflammation and subsequently furuncular eruptions. Apart from these disturbing causes he persevered in the use of electricity for many weeks, and with decided benefit. He is still attending

at the electricity room and his condition at this time, August 23d, is as follows: "Much improved; can flex the knee with tolerable facility and slightly extend the ankles, but in walking the leg is carried forward rather stiffly and with restraint."

September 13th: I have seen this patient to-day at the electricity room. His improvement of late has been rapid and he can now walk some miles.

It is not my purpose to discuss the pathology of cases further than to elucidate their general bearing, but I would remark that however improbable it may appear previous to experience, that pressure on a nerve for a short time should paralyze it so permanently, yet the fact is certain, and as bearing upon the case now before us, I may mention that a medical friend consulted me about two years ago respecting a weakness in the right leg which had troubled him for several weeks.

Upon inquiry it appeared that from some cause which I do not now remember, he was obliged to sleep in a constrained position, which produced pressure on the sciatic nerve, and from that time he dated the symptoms of which he complained. It was nearly six months before the effects of this transient impression passed away.

CASE XX.—**Complete Paralysis of the Hand after a Blow Across the Back of the Wrist.**—F. B——, aged 22, a native of the Orkneys, and employed by the Hudson Bay Company, says he received a blow across the back of the left wrist from a piece of wood a year ago, and from that time he has been unable to produce the least movement of his fingers. There is no lesion of the structures to be detected, the tendons and ligaments of the joints are free and healthy. The muscles of the forearm are flabby and wasted. There is a great diminution of sensation in the whole hand from the wrist downward. The branches of the ulnar nerve are less affected than those of the other parts.

Galvanism to the affected parts was ordered and persevered in for three weeks but without any good effect. He then became impatient and left off treatment. It is to be regretted that he did not attend long enough to test the value of static electricity, as I cannot but think from my experience in similar cases that the best results would have followed.

This pathology of this case is of particular interest, since it does not at once appear why a blow on the wrist should lead to a loss of power over the muscles of the forearm lying above.

CASE XXI.—**Partial Paralysis of the Hand, with Rigidity following the Removal of an Excrescence from the Middle Finger.**—J. J——, a tall, well-made man, but of an irritable nervous temperament, received a bruise on the middle finger, from which resulted an irritable swelling. This was removed and soon after the operation the patient was unable to move the affected finger and the two adjacent ones, and the whole hand became rigid and painful. For this he was sent to the electricity room and sparks were applied to the forearm and hand in the course of the nerves.

Instead of relieving his symptoms, the pain extended up the whole arm, and the electricity was omitted. I heard that subsequently the nervous centres became involved and he died in convulsions.

Paralysis from Lead.—As static electricity has no known influence in eliminating lead from the system, its good effects in paralysis from lead poison are probably limited to its general stimulating action. That this action tends directly to oppose the depressing effects of lead on the nerves and muscles, as well as nutrition generally, is in some measure probable from the fact that its good effects are often distinctly marked while the indications of the presence of the poison in the system remains.

But static electricity is useful rather by tracking closely in the footsteps of elimination and awakening the energies of the wasted tissues after the poison is removed, than as a means of directly subverting its effects. The time within which the beneficial effects manifest themselves is therefore more or less limited by the removal of the poison, a process often remarkably slow.

My experience leads me to entirely agree with Dr. Bird respecting the mode of application of electricity in lead paralysis; namely, that the best results are obtained by drawing the sparks not only from the affected members, but also from the cord itself.

The following table contains the results of the cases under treatment, some of which are detailed in full.

PARALYSIS FROM LEAD.

Name and sex.	Age.	History and extent of paralysis.	Duration of treatment by electricity.	Result.
C. P., male.	42	House painter; blue line on gum well marked; never had colic; 6 weeks ago began to have cramps in the fingers of right hand; the muscles have gradually wasted and the hand dropped; left hand less affected; the middle and ring fingers of both hands flexed into the palms.	Nine weeks; sparks from the spine and down the arms.	Cured.
C. B., female.	47	Husband a painter; never actually in contact with paint, but exposed to its effluvia; symptoms of paralysis in the hands for 5 years, gradually increasing in the last 3; both hands dropped; legs weak; no blue line; never had colic.	Four weeks; not able to attend longer on account of distance.	Considerable improvement.
G. J., male.	29	Painter; second attack; first was 9 years ago; present attack began 7 months ago; has had colic; dropping of the hands preceded by pains in the arms.	Recovered rapidly from his first attack by electricity, used 6 weeks; he attended 3 weeks for this attack; sparks down arm and spine.	Nearly well.
C. P., male.	38	Painter; paralysis of arms 4 months, preceded by pains in the scapulæ and shoulders; flying pains in knees and ankles; subject to a rheumatism several years; twitching in the triceps and muscles of forearm.	Three months; sparks down spine and arms.	Cured.
G. H., male.	35	Painter; colic; three attacks; dropping of hands 9 months; remarkable atrophy of muscles; slight weakness of legs; occasional darting pains in head and between shoulders; blue line well marked.	Three months; sparks from the spine and down the arms.	Cured.
R. T., male.	29	Baker; exposed to the effluvia of a newly painted room when under the influence of mercury for syphilis; hands dropped 3 weeks; blue line equivocal.	Attended with considerable regularity on alternate days for a year; sparks down the spine and arms.	Cured.
J. J., male.	47	Commercial traveller; subject to true gout; dropping of right hand; slight weakness in left (recent); no history of lead poison; one attack of colic; faint blue line on gums.	Five months (with various intermissions) sparks from the spine and down the arms.	Cured

CASE XXII.—**Dropped Hands from Lead Poisoning.**—December 8th, 1848: C. P——, aged 38, a house painter, subject to rheumatism (?) for several years. Four months ago began to suffer with severe pain between the shoulders, which continued until three weeks ago. Soon after the commencement of the pain the arms became so weak that he could not lift them to his head, and his hands dropped. The muscles of the arms as high as the shoulders are soft and much wasted. He has catching pains in the knees and ankles, and occasional twitchings in the triceps and muscles of the forearm. Pain about the insertion of the deltoid and slight numbness and deadness about the nates.

Complexion leaden and icterode. Gums spongy with well-marked blue lines. Has great gouty inflammation of the joint of the great toe, slight thickening about the wrist joints, and œdema on the backs of the hands.

Ordered mist. magnes. c., magnes. sulph. et tinct. colchic., ℥ xx., bis die. Sparks from the cervical portion of the spine and down the arms.

January 6th: Greatly improved, raises the left arm. Cannot at present get the right hand up at the wrist, but the muscles are fast recovering their volume.

Continue the electricity.

Ordered dec. cinchona, acidi nitrici dil. ℥ x., ter die.

March 17th: He has lately gained flesh rapidly. His whole condition improved. Presented cured.

CASE XXIII.—**Paralysis of Extensors of Right Hand from Lead (?), Source of Infection Unknown.**—January, 1851, Mr. J——, aged 47, robust, complexion florid, a traveller for a wine merchant, is subject to attacks of irregular gout probably induced by habits incident to his occupation.

A fortnight ago, when recovering from one of his attacks, was seized with colic which was severe and lasted two days. After a week he began to experience a want of freedom in the movements of the right hand. This rapidly increased so that he was unable to hold his pen, the muscles of his thumb and index finger gradually wasted, and the hand dropped at the wrist.

He consulted me in considerable alarm, fearing some disease of the brain. On examining the gums a distinct blue line was visible. The left hand was scarcely affected. After the most careful and repeated inquiry no history of infection from lead could be obtained, although the evidence was complete. It is not improbable, however, that he may have taken wine containing lead.

Ordered sparks of electricity from the cervical portion of the spine and from the right arm.

To his previous habits and gouty diathesis may be attributed the defects in his depurative functions, and may explain why small quantities of lead from some inappreciable source may have been retained in his system. The medicines prescribed consisted of alkalies and aromatic vegetable bitter tonics.

The patient continued to attend as regularly as his vocation would permit for five months. Since his whole living depended upon the use of his pen, it was with intense anxiety he watched the gradual increase in the wasted muscles, and the return of powers to the hand. Nor was it till the progress had been

verified by his recovery that he could be brought to believe that a true opinion had been formed of the cause of the paralysis. Cured.

CASE XXIV.—**Dropped Hands from Inhaling the Atmosphere of a newly painted Room.**—July 26th, 1851, R. T——, aged 29, a master baker, generally in good health, but now pale and cachectic. Three months ago was under the influence of mercury for syphilis, and at this time had an attack of colic attributable to his shop having been newly painted. He had not himself handled any of the paint. The colic was severe, lasting three days. He felt languid and weak, but had no signs of paralysis for nearly two months afterward. The immediate cause of the affection of the muscles he believes to be cold. It came on rather suddenly after exposure by sitting without his coat at an open window when heated by his work. He had not been exposed to any fresh infection of lead. For the last three weeks he has been losing flesh rapidly. Has had aching pains in the arms and shoulders. Both hands are completely fallen and useless. The muscles of the forearms are wasted, but those of the thumb (commonly so affected in painters) have not perceptibly fallen away. The left arm is rather worse than the right. There is a pale leaden hue of the face, but the blue line on the gums is so slightly marked as to be doubtful.

With the exception of pain in the right knee he has nothing wrong with his lower extremities.

Ordered dec. cinchona c. acid. nitric. dil. ℥ xv. bis die.

Sparks of electricity to be drawn from the spine and down the arms three days a week.

September 8th: Not any very obvious improvement at present. The blue line on the gums more marked than when he was first seen. He continues the electricity and the tonics.

October 6th: Gradually recovering. He has regained the power of raising the arms. The wrists less fallen. Blue line on gums still faintly visible. He continues the treatment.

February 25th, 1852: He can use his hands to dress himself, but is not yet able to work at his trade. He attends regularly.

May 24th: Nearly well. The left hand has not progressed equally with the right. He continues the electricity.

June: Nearly a year has elapsed since the first report was taken. He has been generally regular in his attendance three times a week and is now able to work as usual.

Cured.

CASE XXV.—**Extreme Wasting of the Muscles of the Upper Extremity from Lead. Rapid Recovery under the Use of Electricity.**—G. H——, aged 35, a cachectic-looking man, of thin, spare frame, a painter by trade, has had colic three times—the first sixteen months, the second eleven months, and the third four months ago. For the last nine months his health has been failing him, and his arms have been gradually wasting and becoming useless. He has had great pain between his shoulders and in the knees and ankles. Occasional darting pains in the head. There is now very remarkable wasting of the muscles of the whole of both upper extremities, but especially of the forearm and hands, the muscles of the thumbs, and the interossei. The nutrition of the body generally is very defective, the legs are weak but not obviously paralytic, gums spongy, and a well-marked blue line. The following were the measurements of the arms when he began to use electricity, January 6th, 1850:

Circumference of right forearm at largest part, $8\frac{4}{10}$ inches.

Circumference of left forearm at largest part, $8\frac{8}{10}$ inches.

Ordered sparks to be applied down the spine and down the arm.

January 27th: Much improved; the measurements now are right forearm increased $\frac{7}{10}$ inch, left forearm increased $\frac{4}{10}$ inch.

February 7th: The arms were again carefully measured and the results were:

Right forearm, $9\frac{4}{10}$ inches—gain one inch.

Left forearm, $9\frac{6}{10}$ inches—gain $\frac{8}{10}$ inch.

This improvement continued and he was presented cured at the beginning of March, having attended three months.

CHAPTER XII.

CONTINUATION OF REPORT OF SIR WILLIAM GULL, M.D., D.C.L., F.R.S.

Paralysis during dentition. Descriptive cases. Necessity for electrical treatment. Clinical precautions. Clinical cases with results of treatment. Paralysis following accidents to the extremities. Results of treatment and reasonable prognosis. Clinical histories with results of treatments. Electricity useful as a means of producing passive motion. A clinical case.

Paralysis during Dentition.—The heading of this section would naturally include all the forms of paralysis to which children are subject during dentition, and since these are almost as various as in the adult, it is necessary to explain that the cases here especially alluded to are such as are peculiar to this period of life. They generally bear the following history:

A child from six months to twenty months appears in its usual health, or it has been feverish and troubled with its teeth; but the indisposition, if any, is generally so slight as not to excite particular attention. During the night it is a little restless or even this may not occur, but the following morning on washing it the child is observed not to move its arm or its leg as freely as usual, or it may have lost the power entirely, with this peculiarity that the loss of power if in the arm is especially marked in the shoulder, and if in the leg, the muscles of the hip and thigh. If the child is seen the following day a critical examination may frequently discover some gastric disorder or irritation of the gums. The brain, however, is clear, and but for the paralysis no notice would have been taken of an indisposition so slight that the keen eye of the physician can scarcely detect it.

It is to cases bearing a history corresponding to this that the term "paralysis during dentition" is here applied. It is ob-

viously necessary to define them, as during this critical period of a child's life paralysis appears from very different conditions, such as meningeal apoplexy, from whooping-cough, or other causes, gradual formation of tubercular concretions, caries of bones, etc., in which electricity is either inapplicable, or if harmless can effect but little good.

In paralysis during dentition electricity is a valuable means of restoring the power of the part, and if neglected during the early period of the paralysis irrecoverable wasting of the muscles may follow. Indeed, it will sometimes follow in spite of every care, but such a result is not frequent where precaution has been taken to keep up the nutrition of the muscle by due excitement of its function. If this is necessary in the various forms of paralysis in adults, it is more so in children, whose active yet delicate nutrition so rapidly suffers under depression.

In all infantile diseases this truth meets us at every step, that their tissues are not only active but growing, and hence any arrest of function is doubly injurious. The use of electricity at this age is occasionally beset with some difficulty from the fear and general excitement it occasions. This may be greatly obviated by a few simple precautions, as by letting the nurse sit on the insulating stool with the infant in her arms, and by drawing the sparks through its flannel dress rather than from the naked surface; and if galvanism be the advisable form, by using the same precautions to avoid exciting the fears of the child.

Such hints will not be thought superfluous by those who know how often in the treatment of children's diseases our best efforts are abortive through a want of attention to trifles.

Case XXVI.—**Paralysis of Right Arm during Early Dentition.**—October 1st, 1851: A. E——, aged 12 months, a delicate child with light hair and blue eyes, was in good health six weeks ago and had then cut four incisors in the upper jaw and two in the lower. For a week preceding the present attack, had been feverish and ailing with diarrhœa, but went to bed without anything especially observable in his symptoms.

During the early part of the night he was restless and the next morning his mother observed on washing him that he was unable to raise the right arm, which fell useless by his side, the muscles of his shoulder being quite relaxed. The paralysis has continued and the muscles have wasted. He is able to move the fingers, though not with any degree to raise the arm. There is no sign of irritation about the gums. Ordered sparks of electricity to be taken from the shoulder and down the arm.

January 29th: Much improved. Can raise his hand to his mouth.

February 12th: Still further improvement. Can move the hand and arm in any direction. There remains slight feebleness in the action of the flexor muscles of the forearm.

CASE XXVII.—**Irrecoverable Wasting (?) of the Muscles of the Shoulder from Paralysis during Dentition.**—December 19th, 1850: J. W——, a strumous child, has had paralysis of the arm for the last four months. It came on without any fit or observable derangement of health except irritability incident to cutting her teeth. So soon as it was observed, the gums were lanced and medicine prescribed. The muscles of the shoulder and those that flex and extend the elbow are much wasted. The deltoid in particular has almost disappeared so that the humerus hangs loosely in the capsular ligament. A surgeon to whom the child had been taken, suspecting some dislocation or fracture, had treated it as such by surrounding the joints with adhesive plasters, the effect of which could only be to favor by their pressure the further wasting of the already atrophied parts. Electricity was tried a few times, but the irritability of the child and the unhopeful condition of the shoulder prevented the mother from continuing her attendance.

CASE XXVIII.—**Paralysis of Left Leg during Early Dentition.**—March 18th, 1852: M. L——, aged 20 months. Paralysis of left leg came on suddenly without observation when she was six months old. Symptoms as usual in such cases.

April 6th: This child has been electrified by sparks drawn from the spine, and the affected leg is improved. She can now take three or four steps alone, which she has not done before.

April 22d: Still improving. Her mother then ceased to bring her. She is quite recovered and runs about freely.

CASE XXIX.—**Cervical Paraplegia during Dentition.**—August 21st, 1852: M. A. S——, aged 21 months; a delicate child but healthy during her first year. For the last

few months has been ailing and has had several attacks of gastric disorder. Her teeth have been cut regularly; she has now twelve, eight incisors and four molars, cut a week ago, having been poorly the day previous with feverishness; she went to bed free from her present affection which came on in the night, but her mother does not know when, as the child manifested no restlessness. Upon washing her in the morning as usual, both arms were paralyzed from the shoulders to the elbows, but she could still move the fingers. There appears to be no affection of sensation. The child is intelligent and there is not, nor has there been, any affection of the head. She is now cutting her canine teeth. Her muscles generally are flabby and those of both shoulders already atrophied.

August 21st: Ordered sparks of electricity from the spine and down the arms.

August 30th: The power over the muscles of the shoulder is slowly returning.

September 11th: She now raises the right arm to her head, and although rapidly recovering power over the left the shoulder is still rather weak.

CASE XXX.—**Paralytic Weakness of Arms.**—March 8th, 1850: M. A. B——, aged five months, a well-grown and healthy-looking child having recently recovered from a secondary eruption.

The mother states that about a month ago she noticed the child had lost the power of lifting up its arms, the right seeming to be the weakest. These symptoms have not been attended with any fit, nor with spinal or cerebral irritation.

Ordered mild mercurial every night, and sparks of electricity from the spine and affected limbs.

CASE XXXI.—**Paralysis of Left Leg during Dentition.**—April 18th, 1848: T. W. F——, when ten months old, during the cutting of his first teeth, he lost flesh and was generally much reduced.

At this time his mother observed the left leg was weaker and smaller than the right. His general health is good and has been so, although he was weaned at the age of two months, his mother having had an acute attack of rheumatism. He has never had any distinct fit. The child is well nourished except the left leg, the muscles of which are flabby. He can, however, move it in any direction but not stand on it.

Ordered sparks of electricity down the spine and from the affected leg.

May 15th: He is able to stand without assistance. He continued to improve, but the time which electricity was further employed is not noted.

CASE XXXII.—**Paralysis of the Right Leg and Partially of the Left.**—March 20th, 1848: T. S——, aged 13 months. Light complexion, blue eyes, intelligent face, has always been rather delicate, and when seven months old had an attack of gastric fever lasting three weeks. As he was recovering his mother observed that he had lost the power of using his right leg, and there appeared to be some weakness of the left. For the last six weeks he has been under treatment and his general health is much improved, but the right leg remains powerless and the left weak.

Ordered sparks of electricity down the spine and down the legs.

March 23d: He can move the toes of the right foot, which he has done before the attack.

Continuing the treatment.

May 12th: Is gradually regaining motion in the right leg. Left still remains weak.

Although the history and partial progress of many similar and more illustrative cases have been recorded in the books, our labor has often been rendered useless and our experience imperfect by the mothers abruptly ceasing to attend, in some instances probably finding no advantage, and in others from the children being so far recovered as to be able to use the limb.

Paralysis following Accidents to the Extremities.—Among the various forms of loss of muscular power in which electricity is beneficial, in few are its good effects more marked than in such as follow upon accidents to the extremities. Many of the cases admit of only partial relief, but this is no disparagement of the remedy, since even in them it often effects more than we should have ventured to hope. There are two different conditions resulting from injury to the extremities in which this stimulus is applicable and its mode of action in the two is somewhat different.

When from direct force or dislocation a nervous trunk lying near one of the larger joints has been pressed upon or lace-

rated, electricity produces its good effects by keeping up the tone and nutrition of the parts below during the repair of the injury; second, when rigidity of the joints follows upon thickening of the ligaments of the structures and tendons about them, and the patient is thus prevented from using the limb, electricity enables us to produce passive motion under a form which has advantages peculiar to itself, for it not only flexes the rigid joints but augments the strength of the muscles which have been weakened by disease.

CASE XXXIII.—**Paralysis of Left Arm from a Fall on Shoulder.**—January 21st, 1852: T. E——, aged 63, a stout, robust man, a month ago received an injury to the left shoulder by stumbling over some obstruction on the pavement. In his fall the whole weight of his body was thrown on the head of the humerus, probably displacing it toward the axilla, injuring the brachial nerve and pressing upon the vessels (vein). The arm was left completely paralyzed, both in sensation and motion and became inflamed and very œdematous. Mr. Cook was called to the case and ordered leeches and fomentations. The immediate effects of the injury except to the nerves having passed away he began the use of galvanism on the 16th of January. This was continued for two months without any improvement, the arm still remained paralyzed and without any sensation below the insertion of the deltoid, the hand and arm being also more or less œdematous.

Sparks of electricity were substituted on the 17th of March for the galvanic shocks and employed daily.

August 31st: This patient has continued to attend up to this date, and sparks have been drawn daily from the whole length of the arm, in the course of the muscles and nerves, with the most marked benefit. At the end of May he regained the power of flexing the arm, and began to feel as low as the middle of his forearm. At the beginning of July he perceived he had slight power over the fingers, and the sensation returned as low as the wrist. Thus gradually has he improved; and now can lift the arm as high as the head, flex the elbow with freedom, and bend the fingers into the palm. Sensation has been regained everywhere, except at the tips of the fingers.

I have already seen a case of more interest than this. It appeared for months so hopeless that it was only by repeated

assurances to the patient of a measure of relief that he could be induced to persevere in the use of electricity; and although I cannot attribute all the result to its means, since time, as I have said in my preliminary remarks, was no doubt doing good service in removing the product of effusion from the injured nerves; yet the advantages of treatment must, with this abatement, still be highly estimated. For nearly eight months has he paid his daily visit to the electricity room, and although for the first four he scarcely perceived any improvement, there is now a certain prospect of his being presented quite well.

CASE XXXIV.—**Paralysis and Wasting of Left Arm after Dislocation.**—January 6th, 1851: E. B——, aged 30, a spare and weakly man, states that in May last he was thrown from a cart and fell on his left side, and dislocated his shoulder. This was soon reduced, but the arm was completely paralyzed. It is cold and atrophied. Circulation in the larger vessels normal. The following are the measurements of the two arms:

Circumference of left forearm at the upper part, nine and four-tenths inches.

Circumference of right forearm at the upper part, eleven and three-tenths inches.

Circumference of left hand (thumb included), eight and nine-tenths inches.

Circumference of right hand (thumb included), ten and four-tenths inches.

Ordered sparks of electricity to be drawn in the usual manner from the shoulder downward.

He attended regularly until the 27th of February (seven weeks). The most marked improvement took place during the first fortnight. When he left off attending, he had quite regained the power over the wrist and shoulder. There was still some want of freedom in the movements of the fingers.

CASE XXXV.—**Paralysis of the Arm from a Fall on the Shoulder.**—June, 1850: R. T——, aged 23, was thrown from a chaise a fortnight ago, and rendered insensible by the fall. On recovering himself he was unable to raise his left arm, and had numbness in the course of the musculo-spiral nerve. No inflammation followed the blow, but the paralysis remained. He was ordered electricity, and sparks were drawn from the deltoid and in the course of the nerve. At the end of four weeks he was presented cured.

CASE XXXVI.—**Paralysis of the Arm after Dislocation.**—November 6th, 1850: J. N——, aged 60, had dislocation of the shoulder last April, which was quickly reduced; since that time he has had paralysis of the flexors of the right hand, which are much wasted, especially those of the thumb. There is a feeling of coldness and numbness about the arm and a want of feeling in the little finger.

Ordered sparks of electricity from the affected arm.

November 21st: Improved.

November 28th: Still better.

December 22d: Has not attended for a fortnight, was at that time nearly well.

CASE XXXVII.—**Weakness of the Arm from a Strain of the Shoulder.**—November 20th, 1851: J. B——, aged 55, a corn porter, in February last, while lifting a sack of corn, strained the muscles of the right shoulder-joint: on the next day he was unable to raise the arm, and had considerable pain in it; for this he used liniments but without benefit. In June he was admitted into the hospital under the care of Mr. Hilton. For nine weeks starch bandages were applied and for five more he wore splints. Neither of these measures gave him any relief, and it is now a fortnight since he discontinued them. He has a weak heart and ossified arteries, the brachial of the right side being very rigid, the veins also are dilated. There is great weakness about the shoulder-joint, and the muscles are wasted; he is also unable to close the hand.

It was supposed that there had been a rupture of the tendon of the biceps, but the head of the humerus is not now in any degree thrown forward.

Ordered sparks to be drawn from the shoulder and down the arm.

The improvement in this case was remarkable and rapid. On the 27th of December, four weeks after the commencement of the treatment, the report runs thus: "Much improved; he can close his fingers, and raise the humerus above the level of the shoulder." Presented well.

CASE XXXVIII.—**Contraction of the Fingers, and Wasting of the Muscles of the Forearm after Injury to the Hand** (Electricity useful as a means of producing passive motion).—May 29th, 1852: J. R——, aged 64, of spare habit; his general heath good, but he is not robust. Last October received an injury upon the back of the right hand from the bite of a cat, which was followed by erysipelatous inflammation of the part,

extending up the arm. This seems to have been arrested by application of nitrate of silver. On its subsidence at the end of near twelve weeks the fingers remained extended and rigid, so that he was unable to move them in the slightest degree. The muscles of the forearm were also so much wasted that the circumference of the upper part was three-fourths of an inch less than on the opposite side.

He was treated by faradism, the hand being immersed in a basin of warm water, with one pole of the electro-magnetic coil, while the other was passed along the course of the muscles. This at once produced a free motion of the fingers.

June 25th: The good effects of the treatment in this case, although limited, have been very marked. The wasted muscles have recovered their volume, and the power of moving the fingers is considerable.

August 4th: Still further improved, but not so rapidly as at the beginning of the treatment. He attended about four months, and when he left off was able to use his pen.

Case XXXIX.—**Rigidity and Extension of the Fingers following on Injury** (Electricity employed to produce passive motion. Reported by Mr. Chaplin).—May 7th, 1852: A. H——, aged 29. Five months ago, while carelessly holding a knife in his right hand, he struck it with considerable force and drove the blade obliquely into the palmar surface of the fingers over the first and second phalanges. Severe inflammation followed in the index finger, but the wound over the others healed readily. When the whole was well, and the splints and bandages were removed, he found the fore- and middle fingers immovably extended.

From the position and extent of the wound, it is probable that the tendons of the flexor profundus of the index finger near its insertion was divided. Except this the immobility of the other joints probably depends upon rigidity following inflammation at the time of the accident.

Faradism was employed as in the preceding case. This was continued, with some intermissions, three times a week for more than two months, and, except in the first joint of the index finger, the result has been successful, the power of moving the rigid fingers having been regained.

CHAPTER XIII.

CONTINUATION OF REPORT OF SIR WILLIAM GULL, M.D., D.C.L., F.R.S.

Chorea. Confirmative testimony regarding the value of static electricity. Discussion of cases previously reported by Addison and Bird. Table of twenty-five cases. Clinical histories of selected cases with results of treatment.

Chorea.—In the fifth number of these reports, Dr. Addison contributed a valuable paper "On the Influence of Electricity in Certain Convulsive and Spasmodic Diseases," and there recorded several cases of chorea successfully treated by electricity. The illustrations were not numerous, but they were unequivocal, and sufficient to render it highly probable that electricity was in fact a remedial agent in this disease.

Further evidence tending to confirm the results already obtained was given by Dr. Bird in his report in the twelfth number. He there gives a table of thirty cases: twenty-three cured, five relieved; one not relieved; and one "left from alarm." On looking critically to this table, the results require some modification. The case not relieved was probably not chorea, but paralysis agitans, occurring as it did at the age of sixty-one. The other, said to be "chorea limited to the sterno-cleido-mastoideus," is the affection commonly called "spasmodic wry-neck," and should not, as I believe, be classed with chorea, but rather with paralysis agitans, or, indeed, occupy a place by itself. If we except these cases, the results of the other twenty-seven are: twenty-two cured, five relieved. Here we have, therefore, great confirmatory evidence of the results offered by Dr. Addison.

In the eighth number of the second series of the reports, Dr. Hughes, in his "Digest of a Hundred Cases of Chorea," speaks especially of the value of electricity. It was employed in fourteen of his cases: "Several of them were of the most severe form and of considerable duration. It effected a cure in nine and failed in five. Of the successful cases, it was used in combination with zinc in five, and with iron in one." He adds: "The effects of electricity in chorea are sometimes remarkable. On some occasions I have known it to effect a cure after a great variety of other remedies had for weeks and months been tried in vain; when the body had been wasted and the mind was apparently giving way, and the disease proceeding unchecked, if not increasing, notwithstanding a variety of remedies employed assiduously and for a long time, electricity has, under my observation and direction, effected a real and marvellous change, and this change has not been more beneficial than it has been rapid."

The cases included in the present report are confirmatory of the opinions formed by these excellent observers. I have many times witnessed the most decided good effects of electricity in chorea. It has appeared to me to effect most good when the whole spinal system has been implicated, where the movements have been both *universal* and *severe*, provided there has been no complication. I have seen children so severely affected that it was with difficulty they could be held on the insulating platform or retained on the knee of the nurse, while the sparks were being drawn from the spine, and yet after two or three applications become so much better that they have sat up by themselves, and after a few attendances walked into the room without support.

My experience does not confirm the statement by Dr. Bird, that "electricity does not appear to be less useful as a remedial agent in cases in which the involuntary movements are confined to a single limb or a few muscles of the body." This remark requires limitation, as the cases of local spasm or invol-

untary movements cannot all be associated in one class. The pathological conditions leading to them are often very different and so are the effects of treatment.

We must be especially cautious not to be misled by cases occurring at or after the middle period of life; for although true chorea may occur at any age, it will be admitted that in advanced life the cases of involuntary action of muscles are more commonly allied to paralysis agitans, and are often but the precursors of a more general affection, although even among them there is considerable diversity, as I shall attempt to show further on.

All proper exceptions being removed, the fact stands well established that electricity is at present to be ranked among the means at our disposal for the cure of chorea, and that in severe cases its effects are often truly surprising.

Where other means cannot be employed, where the patient is scarcely able to swallow; where the skin is abraded from the prominent bones of the emaciated frame; when the powers of life seem nearly exhausted, sparks of electricity drawn from the whole length of the spine will often, after a few repetitions, effect a favorable change and enable us to administer other means of cure.

Not only in these extreme cases does this agent greatly help us, but in minor ones its effects are proportionate.

Since, however, chorea, like names applied to other diseases, does not express a constant and invariable condition, the means of cure must be varied, and of course electricity not being applicable to all cases, must fail in some. It did so in the cases marked XII., V., and II. in the table.

Case XII. is remarkable from the age at which it occurred (male, aged 43). It was a genuine case of chorea, and the conditions which opposed his rapid recovery were not obvious. He was but little benefited by the treatment. The tonic plan and electricity also failed in Case V. My previous experience had led me to expect this unfavorable result, since I have observed

the same in most cases where chorea is complicated with any signs of membranous irritation, or with a tendency to permanent spasm.

In such conditions alteratives effect the cure. It will be observed that the cause of chorea in this child was overstudy, and that in early life he had had decided affection of the brain.

Case II. in the table was only partially cured. The movements were here limited to the face and head, and were, perhaps, rather the result of habit than any condition combatable by medicine. It will be admitted that children having congenital deficiencies in the nervous centres are rather prone to these slight vagaries.

CASES OF CHOREA.

No.	Name.	Age.	Conditions.	Course and duration of symptoms.	How Long electricity employed.	Result.
1	Ann K.	13	Delicate; a nurse girl.	Frightened by accidentally letting the child fall she was nursing; both sides affected, but left most.	4 weeks.	Cured.*
2	Joseph H.	11	An irritable and delicate subject, not well grown; congenital deficiency in the growth of the left eye.	For some months has had chorea movements, principally affecting the face, and producing an awkward shaking of the head; no obvious exciting cause; no bruit.	8 weeks.	Not much improved.
3	George B.	12	Pale and scrofulous; subject to boils.	Frightened; had a fit at the time of the fright; chorea affecting arms principally; no abnormal bruit with heart's sound.	4 weeks.	Cured.
4	Eliza B.	8	Delicate child; has had rheumatic fever.	Chorea 9 weeks; affected the right arm first, and gradually extended to the voluntary muscles generally; rheumatic fever(?); no abnormal sounds about the heart.	7 weeks.	Cured.
5	John D.	10	Intellectual expression; well-formed head; strabismus of left eye.	Overwork at school; chorea 4 months, affecting voluntary muscles generally; no abnormal bruit with heart's sounds.	12 weeks.	Not much improved.
6	Fanny W.	13	.....	Second attack, one a year ago, lasting 11 weeks; first attack from seeing another child with it; for second, no obvious exciting cause; no bruit.	5 weeks.	Cured.
7	Emma C.	17	Well formed and healthy, except a slight pallor.	Fright a month ago; catamenia arrested at the time; left side only affected, and the arm most; slight anæsthesia; no	4 weeks.	Cured.

* The improvement in this case was ren
she was not able to walk; after the

the electricity room
assistance.

CASES OF CHOREA.—*Continued.*

No.	Name.	Age.	Conditions.	Course and duration of symptoms.	How long electricity employed.	Result.
8	Jemima S.	10	Head not well formed; health good.	No evident exciting cause; chorea 5 months, affecting left side only.	12 weeks.	Cured.
9	Anne H.	13	....	Seven weeks ago had small-pox; chorea 3 weeks, severe and general; speech almost inarticulate.	4 weeks.	Cured.
10	Catherine G.	16	General health good.	Bruised the right arm by a fall; after 3 weeks the arm continuing painful; choreic movements began in it, from thence extending to the right leg and to the left side.	8 weeks.	Cured.
11	Edward K.	6	A delicate child, thin and pale; has gradually fallen off in his appetite.	Nine weeks ago began, contrary to habit, to take his food with the left hand; chorea movements, gradually affecting the whole right side; speech indistinct; left side not much implicated.	3 weeks.	Cured.
12	John L.	43	Married; habits regular; face dull and inexpressive; nutrition moderate; never had rheumatism.	Fell overboard two years ago; was nearly drowned 9 months after; general choreic movements began.	6 weeks.	Not cured.
13	Rose H.	9	Vacant expression; strumous constitution.	Fright; chorea 6 weeks.	8 weeks.	Cured.
14	John R.	12	Strumous appearance.	Three months ago had rheumatic fever, lasting a month; health previously good; chorea 6 weeks; articulation much affected; movements general.	7 weeks.	Cured.
15	William C.	17	Pale and thin; has worked in a damp situation; 2 months ago had rheumatic fever.	The choreic movements supervened as he was recovering from rheumatic fever; left side only affected; speech indistinct.	After 9 applications he was considerably improved; attended 1 month.	Nearly cured; was impatient to return to his work.
16	Emma R.	8	.....	Chorea 6 months, principally affecting right side, following immediately upon a fright.	4 weeks.	Cured.
17	Sarah L.	20	Dressmaker, subject to much anxiety.	Four months ago first observed irregular motion and twitching in right hand, gradual extension to other parts, but principally affecting the right side.	1 week.	She was improved by her short attendance.
18	Frederick F.	12	Thin and fair; head large; subject to strumous enlargement of cervical glands; has ascarides; heart's action irritable; no bruit.	Severe chorea 3 weeks; no evident exciting cause.	3 weeks.	Cured.
19	Maria H.	15	Tall and thin, with fair complexion, auburn hair; of delicate constitution; heart irritable; rhythm irregular; no bruit.	Chorea gradually supervened 3 months ago; right side principally affected; caused by fright; attack severe; she cannot walk without assistance.	8 weeks.	Cured

CASES OF CHOREA.—*Continued.*

No.	Name.	Age.	Conditions.	Course and duration of symptoms.	How long electricity employed.	Result.
20	Edgar S.	16	.....	Three previous attacks; right side principally affected; present symptoms date from 3 months ago.	7 weeks.	Cured.
21	Elizabeth R.	6	A fair, delicate child, ill nourished.	Second attack; first a few months ago; exciting cause not evident; bellows murmur.	3 weeks.	Cured.
22	James F.	10	A fair healthy-looking child of rather spare frame; heart's action frequent.	Third attack; first two years ago, from falling overboard; second a year ago; present a fortnight; movements general; no valvular murmur.	7 weeks.	Not quite cured; slight movements still observed.
23	Eliza B.	10	Thin and sallow; has passed worms; heart's action frequent and irritable; no bruit.	Chorea, principally to right side, for several months.	8 weeks.	Cured.
24	Joseph S.	9	Scrofulous constitution: dark hair; head large; general health good; subject to ascarides.	Chorea 5 months, principally to left side; father had chorea; has been harshly treated.	8 weeks.	Cured.
25	Hine M.	9	A thin delicate girl; sallow complexion.	Fright; movements principally affect the arms; duration 3 months.	4 weeks.	Cured.

CASE XL.—**Chorea Excited by Overstudy: Failure of Tonics and Electricity; Cure by Mild Mercurials** (Reported by Mr. Moor).—January 22d, 1853: F. D——, aged 10, a delicate child of fair complexion and susceptible nervous system, which in infancy resulted in decided cerebral irritation, leaving permanent strabismus of the right eye; has been the subject of chorea four months, from the over-stimulus of competition at a public school, where he has already much distinguished himself. The movements began gradually, and affected both sides of the body equally. The action of the heart is frequent, and without any abnormal bruit. The digestive organs are in an atonic state. He is apt to reject his food, and there is occasional diarrhœa.

When he first came under treatment he was ordered vegetable bitter tonics and iron, with port wine and a carefully regulated diet, and after a short time, sparks were drawn from the spine three times a week. This treatment with such variations in the medicines as circumstances required, and comprising the metallic tonics was continued from January 22d to April 13th. At this last date he was somewhat improved but not cured. The treatment, however, was discontinued; and the child being again exposed to the excitement of his home, he gradually fell

back into his former state and was again admitted under my care on the 5th of May, when his symptoms are described by Mr. Moor, who kindly reported the case: "Constant jactitation of the whole body, complains of pain in the head over the forehead; rest disturbed; face pale; impaired appetite; digestion weak; constipation; heart action without any abnormal bruit; rhythm irregular." Ordered:

Pulv. rhei salin., ...	ʒ i. p. r. n.
Ext. gent. co., ...	gr. iij.
Zinci sulph., ...	gr. i. ter die.

The dose of zinc was gradually increased, and on the 21st of May sparks were again ordered to be drawn from the spine. This treatment was continued until the 8th of June, when he was taking eight grains of sulphate of zinc three times a day.

There was no improvement in the symptoms, perhaps the movements had rather increased, and the child often complained of pain in the head. The failure of the usual remedies, the presence of the strabismus, his early history, and the apparent cause of the disease, now led to an alteration in the treatment and he was ordered: hydr. cum creta, gr. iij. omni nocte.

This was continued until the 2d of July, when all chorea movements had disappeared.

On the 9th of July the haust. quiniæ bisulph. was prescribed to be taken every morning.

On the 13th this was omitted, as the movements had begun to reappear.

I have recorded this case in full as another instance of what has occurred in the experience of all—namely, that both in chorea and hysteria there is occasionally a state of brain requiring the substitution of a mild alterative mercurial plan for the more common one of tonics. The circumstances determining our choice are such as point to a combination of cerebral irritation with the chorea and hysteria, and out of which the latter have probably arisen.

The hydr. c. creta was repeated every other night until the 27th, when he was again quiet. All medicines are now omitted. He remained under observation for three weeks, taking the air every day, and at the end of that time he was presented well.

The case of J. H—— (II.) presented peculiarities distinguishing it from the ordinary cases of chorea. It will be observed that there was a congenital deficiency in the left eye and his slight and undeveloped frame showed a great predisposition to nervous derangement, while the movements themselves were probably rather the result of habit than of chorea. They consisted in an awkward jerking of the head and twitching of the muscles of the face, movements which are often as habitual to a person as his ordinary expression.

CASE XLI.—**Chorea Following Small-pox** (Reported by Mr. Lewis Newnham).—November 2d, 1856: A. F——, aged 13, had small-pox seven weeks ago and as she became convalescent her mother observed her movements to become quite unsteady and her speech indistinct. These symptoms increased in intensity, and the chorea soon became general and so severe that if she attempted to feed herself she would throw the food over her shoulder. When she first came under observation this was her condition: The appetite was good; intestinal secretions healthy. Ordered: zinci sulphatis, gr. ij. ter die.

November 16th: No improvement, the dose of zinc increased to three grains three times a day.

November 24th: Symptoms severe, the articulation is extremely affected. Ordered sparks to be drawn from the whole length of the spine three times a week.

December 4th: She can now sit without being held on the insulating stool, while the sparks are being drawn.

December 16th: Walks to the electricity room unsupported.

December 20: Rapidly getting well.

At the beginning of January she returned home perfectly cured.

CASE XLII.—**Chorea After a Fall and Slight Injury to the Left Arm** (Reported by Mr. Lewis Newnham).—C. R——, aged 16, a strumous girl with dark complexion, was in good health until three months ago, when she accidentally fell and struck her right arm near the insertion of the deltoid; the blow was rather severe. The injured part remained very painful, and after three weeks the arm began to twitch involuntarily. Within a week the leg of the same side began to move in a similar manner, and then the arm and leg of the left side. The movements gradually became more decided, and continued to increase until she came under treatment.

[illegible] Ordered sparks to be drawn from the [illegible] spine three times a week.

[illegible] She came regularly, and is improved.

[illegible] Much better. It may be mentioned that she has an improvement in her speech, but this is independent [illegible]

She continued to attend until March 30th, when she left [illegible]

[illegible] — **Chorea. Cause Uncertain, Probably Fright.** [illegible] laborer of middle stature and well developed was admitted into the hospital under the care of Dr. [illegible] In the course of treatment was sent to the electric [illegible] when the following notes were taken of his history and present condition. He has been married twelve years, and dates his present illness from two years ago, while living in [illegible] at that time he fell overboard and was nearly drowned, but felt no immediate inconvenience beyond the fright. After three months he began to find an unsteadiness in his gait, and slight involuntary movements in the face and extremities generally. He has no headache, no confusion of intellect, nor is his memory obviously impaired, although there is a remarkably dull and stupid expression. His digestion is good; bowels regular; heart action normal, but feeble. Never had rheumatic pains. The face and hands have a congested venous appearance. There is nothing peculiar in the character of the chorea movements, neither are they severe. His gait is unsteady; the articulation slow and often imperfect.

He was treated by various nervine metallic tonics, and sparks of electricity were drawn from the spine.

This treatment was continued for six weeks, at the end of which time he was presented; but not cured.

CASE XLIV. **Chorea Following Acute Rheumatism.**—J. R[illegible], aged 12, at present a delicate-looking boy, but his mother says he had excellent health up to three months ago, when he had an attack of rheumatic fever, which lasted a month. When he began to get about again, his mother observed an awkward movement of his head and unsteadiness in the use of his hands, and so uncertain a gait that he could not walk without danger of falling. He was treated with the sulphate of zinc for six weeks, but with very little improvement.

On first coming to the room the chorea movements were well marked, and his mother says are sometimes so much aggravated that he can scarcely speak or walk. These unfavor-

able changes seem to be in some degree dependent upon the weather, which greatly depresses him if it is cold and damp.

December 6th: Ordered sparks of electricity to be drawn from the spine three times a week.

19th: Some improvement.

January 14th: The treatment has been regularly continued. Presented cured.

CASE XLV.—**Chorea without Obvious Exciting Cause.**—J. S——, aged 9, a scrofulous child with large head, dark complexion, and long eyelashes. He has been well, and generally enjoyed good health with the exception of a headache, of which he has long and often complained. The bowels are regular, tongue clean and moist, appetite good; he is troubled with ascarides; heart rhythm rather irregular with an occasional mitral bruit. His father had chorea when a child.

November 8th: Ordered pulv. rhei c. hydrarg., gr. x. st.; and sparks of electricity to be drawn from the whole length of the spine three times a week.

24th: He improves so little that he is ordered zinc. sulphatis, gr. i. ter die, and to continue the electricity.

December 7th: The zinc has been gradually increased. He now takes three grains four times a day. Electricity continued.

11th: Is improving. The dose of zinc is increased to four grains; electricity continued.

At the beginning of January he was presented cured.

CASE XLVI.—**Chorea from Fright.**—M. A——, aged 15, a tall, thin, fair girl, with auburn hair, delicate constitution, rendering her subject to catarrhs and cynanche; often suffers from headache. She has never menstruated. Three months ago she was very much frightened while living in service with a lady who was insane. After the fright chorea movements gradually came on in the right side, and are now so severe that she cannot feed herself. The heart action is increased in frequency, rhythm irregular, no bruit.

She has taken zinc and iron and is somewhat improved but she is still unable to walk without assistance.

March 20th: The treatment has been continued up to this time, and she is now almost well. Presented cured.

CHAPTER XIV.

CONTINUATION OF REPORT OF SIR WILLIAM GULL, M.D., D.C.L., F.R.S.

Wry-neck from spasmodic affection of the muscles in adult. How distinguished from chorea. Results of treatment unsatisfactory. Clinical histories of cases treated without cure. Paralysis agitans. Treatment unsuccessful. Clinical histories of cases treated. Mercurial tremor. Great benefit derived from static electricity. Clinical history of case successfully treated. Summary of results in the treatment of amenorrhœa. Method of treatment. Table of twenty-two cases. Clinical histories of selected cases with results of treatment. Close of Sir William Gull's report.

Wry-Neck from Spasmodic Affection of the Sterno-cleido-mastoideus and Trapezius, Occurring about the Middle Period of Life.—Several cases of this affection have been treated by galvanism and static electricity for a lengthened time, but without continued benefit. Some of the observers regard spasmodic wry-neck as a form of chorea, an opinion which is not, I think, well founded, for although it is true that in chorea and hysteria the muscles of the neck are frequently affected, we must distinguish between these cases and those depending upon a definite irritation of the spinal accessory nerve of one side, occurring mostly in adults at or after the middle period of life. It may be objected that chorea is sometimes limited to a few muscles, or even to a single one; but limited howsoever it may be, it will be admitted that it is associated with a more general condition recognizable by the experienced eye. Moreover, chorea movements are irregular and indefinite, while the spasmodic wry-neck of adults is a more uniform clonic spasm.

There are other circumstances which, if this were an essay on pathology, might be adduced. These may perhaps suffice

to individualize the complaint for the purpose of discussing the value of electricity, which, although it does so much good in chorea, effects but little here; more success having attended the administration of the mineral tonics, attention to the general health, and change of air.

Wry-neck in hysterical subjects during the early years of menstruation, like the other muscular vagaries to which they are prone, frequently disappears as suddenly and mysteriously as it came. Electricity does much good in these cases, but probably no more than any other means which would produce a decided impression, and call off the mind from its subjective musings to some external subject.

CASE XLVIII.—**Spasmodic Wry-Neck Excited by Fatigue.**—W. W——, aged 50, a thin, pale, and nervous woman, had for some time previous to the distortion of her head to one side been troubled with an uncomfortable sensation of weakness and pain in the opposite shoulder which was greatly increased by fatigue. She attributes her symptoms to having overtired the arm by carrying a heavy basket of china. The spasm of the mastoid muscle did not follow for near six months afterward, but she connects the two together from having, after the fatigue, felt an occasional pain about the neck.

Sparks of electricity were ordered from the cervical portion of the spine and down the side of the neck.

She continued to attend for several weeks without obtaining any relief.

CASE XLVIII.—**Spasmodic Wry-Neck; Exciting Cause not Evident.**—October 11th, 1848: Mr. M——, aged 43, a draper living at Lambert, always enjoyed good health. Eight months ago without any obvious cause his head began to be turned involuntarily to the right side. The distortion has gradually increased. Slight pain in the left side of the neck, and sterno-cleido-mastoideus of the side appears hypertrophied probably from the continued spasmodic action. The movements of the head are much increased by excitement, and relieved by quiet and rest. During sleep they cease altogether. Excepting this affection of the neck he feels quite well.

Ordered sparks of electricity to be taken from the upper part of the spine and down the side of the neck.

November 12th: He has been gradually improving. Novem-

ber 24th: He has relapsed since the last report, and attributes the change to the dampness and coldness of the weather. He continued to attend for a short time, but found no permanent relief. Two other cases, the details of which are similar to the preceding, were treated by electricity and galvanism for several months. The one was a man, aged 48; the other a woman, aged 37. In the latter case, both direct and inverse continuous galvanic currents were employed, as well as sparks of electricity, but no favorable impression was made upon the spasmodic affection of the muscles. In the former case, after a long trial of electricity, the disease yielded to sulphate of zinc gradually increased to a large dose. The patient relapsed after a few months, and was again beneficially treated by the same medium.

CASE XLIX.—The following case of spasm of the platysma myoides on both sides of the neck is allied to those in which the sterno-cleido-mastoideus is similarly affected (reported by Mr. Chaplin): October 15th, 1851, Mrs. S——, aged 56, has ceased to menstruate ten years. With the exception of occasional giddiness had good health until the commencement of present complaint two years ago. At that time she had a great fright on suddenly missing from her pocket a sum of money. This caused peculiar sense of weight in the top of head. The skin of the forehead and face seemed drawn tight, and she felt a difficulty in opening her eyes or lifting up the head from the chest. She applied to one of the dispensaries, and was treated by cupping, leeching, and blistering, which much increased her symptoms. At present her general health is considerably deranged. She complains of sense of weariness on exertion and pain in the back of the neck and across the shoulders. The arms are weak, but there is no trace of paralysis anywhere. The head is bent toward the sternum with an inclination to the left side. She is unable to keep it quiet, especially when excited or making any exertion. This tendency of the head toward the sternum is seen to depend upon a spasmodic action of the platysma myoides on either side, throwing the integuments into transverse folds and giving a peculiar "risus" to the mouth. Tongue furred; appetite bad; bowels costive; palpitation and dyspnœa on exertion. There is an irritable state of the nervous system generally, and she states that at the end of the last year, and during the early part of this, her feelings were greatly depressed and she was much troubled with vicious and suicidal thoughts.

This case was treated by a current of galvanism through the

muscles of the neck and along the cervical portion of the cord, and she took ammonia with serpentaria.

At the end of a month there was no improvement, and sparks of electricity were substituted for the galvanic current. She was also ordered gentian, aloes, and ammonia. This plan was persisted in for many weeks; but she found herself no better, and feeling too nervous to trust herself alone in the streets in coming to the hospital, she left off attending on February 14th, 1852. Not cured.

CASE L.—**Wry-Neck Following Rheumatism (Electricity not Admissible).**—The following case is valuable, not as showing the good effects of electricity, but as presenting a curious pathological condition, which gave rising to the twisting of the head. It was sent to the electricity room for the purpose of trying the effects of this great agent, but a more minute inquiry showed plainly that no benefit could be gained from it.

S. R——, aged 14, but looking six years older, a stout and swarthy Italian. Four years ago had acute rheumatism, brought on by bathing. After the attack the head became gradually drawn slightly backward, and the face directed to the left side.

The case differed from the common forms of wry-neck in the absence of all jactitation, and in the entire inability to hold the head straight. On examining the right sterno-cleido-mastoideus, the origin of the clavicular portion of the muscle was found to be degenerated, probably from some rheumatic affection, and had gradually contracted into a fibrous cord, the general body of the muscle being apparently healthy.

Instead of using electricity, which could have been of no use, he was advised to have the contracted portion divided by a knife, but to this his father objected, and he left in the same state.

Paralysis Agitans.—Electricity has been carefully applied, and long persevered in, in special cases of paralysis agitans, but the results have not been encouraging. The following cases have been selected as examples:

CASE LI.—**Paralysis Agitans of Right Arm Owing to Exposure to Cold** (Reported by Mr. Chaplin).—October 15th, 1851: H. H——, aged 60, a pale, cachectic woman, about the middle stature. Nutrition defective, lips livid, and complexion of a leaden hue. Has usually been weak and delicate and experienced great vicissitude of fortune. Three

months ago sat for some time near an open window, the wind blowing upon her arm. This caused a severe rheumatic pain in it which continued a month, and at the end of that time she perceived a slight trembling in the hand, which had gradually increased. The right arm now constantly trembles, unless it is supported. No other part is similarly affected. The tongue is protruded steadily and quite straight. She has never been subject to pain in the head, nor had a fit of any kind.

Ordered sparks of electricity from the spine but in particular from the cervical portion.

February 14th: No visible improvement; but during the last ten days she has pain in the left arm accompanied by slight twitching. No anæsthesia in the affected limbs. There has been no headache in the course of the case. Her symptoms are much increased by change of temperature. Ordered: julep ammonia, ter die; pulveris nucis vomicæ, one-half gr. in pil. cum sing. dos. misturæ apiend. Electricity to be continued.

March 16th: General health much improved but the tremor not lessened.

April 5th: Electricity discontinued, no improvement.

CASE LII.—**Paralysis Agitans** (Exciting cause not evident).—J. P——, aged 34, a strong muscular man, having a weatherbeaten appearance, and looking more than ten years older than he is, has been an engine driver of one of the steam-tug boats on the river, and has drunk freely of the spirits and porter. He dates his present symptoms from four years ago, when he began to have an aching pain in the left shoulder, soon followed by trembling of the muscles, and in the course of a year extending down to the hand. The leg on the same side was similarly affected, and for nine months the disease was hemiplegic.

During the last three months the other arm has begun to shake, and he experiences some premonitory twitchings and tinglings in the leg. Appetite good; bowels regular, circulation natural. He has a broad and low forehead. Pain across the top of the head and down toward the back of the neck. Memory impaired. Sleep disturbed. Occasional muscæ volitantes; sphincters good. No history of blow or other injury.

Ordered sparks down the spine.

After attending six times, he came no more, his symptoms being in no respect changed.

CASE LIII.—**Paralysis Agitans from Exposure to Cold**

(Reported by Mr. Newnham).—April 17th, 1850: R. R——, aged 45, a fair healthy-looking man, by trade a hatter, states in October two years ago, the weather being cold at the time, he got his clothes wet and sat for a long time in a coffee-room with his wet clothes upon him, and afterward embarked on board a steamboat, remaining on deck all night. The next morning on disembarking he could scarcely walk, his limbs feeling stiff and tired. After four days his right hand began to tremble so much that he could not write, and gradually his whole arm became similarly affected. After eight months his right leg began to feel heavy and to tremble like the arm on the same side. His general health remained good, and although a few years ago he had heaviness in the head, for which he was cupped, yet for some time before the attack and since he has been free from any such symptoms.

Four months ago tremors began to affect the left arm, and in a short time the leg, so that the whole body is in a state of perpetual agitation. No affection of the muscles of expression. Never had rheumatic pains in any part either before or since the commencement of his present symptoms.

Had an epileptic fit first a year before his present illness and has since had fourteen at various intervals.

Ordered sparks from the whole length of the spine.

This treatment was continued until the 27th of May (nearly six months) without improvement. He then ceased to attend.

CASE LIV.—**Paralysis Agitans of Right Arm Following a Blow** (Reported by Mr. Button).—July 1st, 1848: T. E——, aged 50, but looking ten years older, a tall, thin man with an anxious haggard expression; by trade a carpenter, living at Canhall. Had good health until two years ago, when he was struck by a heavy piece of wood on the anterior and outer part of the right upper arm. The injury disabled him from working, and was followed by severe pain down the arm In the course of four or five months, a continued tremor began in it which has gradually increased and ceases only for a short time, when the arm is supported, or for a few seconds by a strong effort of the will. No affection of sensibility.

Ordered tonics and sparks of electricity to be taken from the spine.

The treatment was continued for about two months without improvement.

CASE LV.—**Mercurial Tremor** (Reported by Mr. Benjamin Wood).—May 20th, 1850: J. S——, aged 22, admitted

under the care of Dr. Hughes; a tall, well-made man, has worked for eight years in a looking-glass manufactory. During the first five years he suffered from headache and deafness; and during the last three he had three attacks similar to the present. The imperfection of his articulation and the confusion of his brain prevent our obtaining an accurate account of these attacks. His present symptoms began a month ago. His face had a vacant, languid expression; his voice is weak and remarkably subdued; slight tremor of the tongue, gait unsteady; hands continually trembling unless supported; sensation unaffected, pulse frequent, 120 under excitement; respiration tranquil. He has had several fits, as he terms them, which are no more than violent exacerbations of his general tremors, produced by mental agitation, and which may be arrested by restoring confidence to the mind.

On one occasion, however, he had loss of consciousness; tongue moist and slightly furred; gums spongy; skin perspiring.

Ordered tonics, sparks of electricity to be taken from the spine.

29th: He appears to have derived great benefit from the use of electricity. He was able to-day to come to the room by himself. He complains of headache; the peculiar hesitation in his speech is unaltered.

June 3d: The tremors are now only occasional, but the speech and vacant expression of the face are still unaltered. He was presented well at the end of the month.

Amenorrhœa.—The following table of cases treated by electricity contains all that have been recorded under my observation, where the results have been given.

Of the eight cases in which the electricity produced no effect, in seven there was marked local or general disorder sufficient to render it probable beforehand that it would not effect much. It is obvious that electricity as an excitant of the catamenial secretion must have a restricted application, since amenorrhœa, especially in the more advanced periods of life, is due to morbid conditions requiring the judicious use of medicinal measures for their removal. There can be little doubt, however, that in the earlier periods of womanhood, when the menstrual function has not been fully established and where

the only defect seems to be an inertia of the pelvic organs, static electricity is often of direct and singular efficacy. And in this my experience fully accords with that expressed by Dr. Bird in his reports on this subject.

The mode in which the shocks were employed was the same in all the cases here recorded, and is fully detailed in the report referred to. A Leyden jar containing one hundred and twenty square inches of coated surface was charged to a given tension as measured by a Lane's discharger, and the shocks sent through the pelvis from the pubis to the sacrum about a dozen times on alternate days three times a week.

By means of the discharger the intensity of the shock may be accurately adapted to different susceptibilities, but the distance of half an inch may be regarded as about the mean. Hysterical tendencies are occasionally somewhat aggravated at the commencement of the treatment, but beyond this I have known no inconvenience to follow.

The various modes of treatment adapted to amenorrhœa were employed in all the cases, and continued while they were under treatment by electricity, hence it may be doubted whether the whole of the successful result should be attributed to it; this doubt will be much lessened when it is remembered that the effect of the electrical stimulus was immediate, although the other parts of the treatment had been previously persevered in unsuccessfully for a length of time.

Of the *modus operandi* little can be said beyond conjecture, but it seems probable that it is to the mechanical effect of the shock that the result is due. There are cases in which this treatment may be advantageously preceded by the more general stimulus produced by drawing sparks from the whole length of the spine, but especially from the lumbar and dorsal segments. Where the organic functions are languid and the spinal system sluggish we may by this means often greatly aid the action of appropriate medicines, and at length effect the cure by the more direct and powerful application of shocks through the pelvis.

CASES OF AMENORRHŒA.

No.	Name.	Age.	General state of health.	History of catamenia.	Duration of treatment by electricity.	Result.
1	A. D.	20	Middle stature; full habit; delicate health for the last 2 years.	Amenorrhœa lasting 7 months.	Commenced Jan. 7th, catamenia appeared after use of electricity 3 times.	Cured.
2	E. K.	16	Middle stature; dark hair; womanly development; general health good.	Catamenia have never appeared.	From Jan. 30th to Feb. 10th, when the catamenia appeared, and continued 4 days.	Cured.
3	M. A. P.	16	Rather pale and thin; general health moderately good; subject to severe headache.	Catamenia first appeared 18 months ago; suppressed for last 6 months, probably from fright.	Commenced March 11th; continued for 3 weeks, when catamenia appeared.	Cured.
4	M. T.	16	Delicate; fair complexion.	Catamenia appeared at 15; were regular 9 months; suppressed 4 months from taking cold.	Commenced April 7th; catamenia appeared after twice using electricity.	Cured.
5	M. J.	19	Rather anæmic but otherwise in good health.	Amenorrhœa 4 months probably from cold.	Shocks through the pelvis on 12 alternate days, commencing April 15th.	No result.
6	M. A. B.	18	6 months ago had an attack of brain fever; previously in good health, since has had headache, with hysterical symptoms and generally felt weak and poorly.	Catamenia have never appeared.	Commeneed April 6th; discontinued at the end of the month.	No result.
7	S. W.	17	Rather chlorotic constitution; delicate.	Menstruated first at 15; periods of return irregular; amenorrhœa 5 months.	From May 19th to June 1st.	Cured.
8	M. M.	20	Sanguine temperament; general health good.	Amenorrhœa 1 year; catamenia previously regular.	Commenced May 27th; continued until June 9th, when catamenia appeared.	Cured.
9	E. B.	17	Fair complexion; delicate constitution.	Catamenia appeared at 15½; were tolerably regular for a year; for last 6 months painful and scanty menstruation.	From June 8th to July 13th.	No result.
10	H. C.	17	Robust; fair complexion; subject to pains in head and loins for some months; anorexia, nausea.	Never menstruated.	Commenced June 1st; on July 7th it is recorded that the catamenia had appeared.	Cured.
11	S. H.	29	Married 2½ years; general health delicate; spare frame; complexion florid; leucorrhœa.	Amenorrhœa more than 4 years; attributes arrest to domestic affliction.	From June 19th to beginning of September.	No result.
12	M. B.	18	Nutrition and general health good.	Amenorrhœa for 9 months; catamenia previously irregular, at intervals of 5, 6, or 9 weeks.	Commenced Oct. 18th; catamenia appeared on the morning of Oct. 20th and continued 4 days.	Cured.
13	M. D.	17	Not stated.....	Amenorrhœa 1 year.	Commenced Oct. 17th; on Nov. 22d reported that the catamenia had returned copiously.	Cured.
14	H. E.	19	General health good; complains of heaviness and oppression about the head; no hysteria.	Catamenia first appeared at 17; intervals irregular; amenorrhœa 8 months.	Commenced Oct. 22d; discontinued Nov. 2d; the catamenia appeared and lasted 3 days.	Cured.
15	L. W.	18	Fair; florid complexion; slight muscular development; general health good.	Catamenia have appeared but 3 times, at irregular intervals, 2 years ago.	Commenced Nov. 20th; discontinued Dec. 14th, when the catamenia appeared.	Cured.

CASES OF AMENORRHŒA.—*Continued.*

No.	Name.	Age.	General state of health.	History of catamenia.	Duration of treatment by electricity.	Result.
16	J. C.	26	Dark and florid complexion; vascular excitement; headache, furred tongue, leucorrhœa.	Amenorrhœa 7 months, from cold, previously menstruated regularly.	Commenced Nov. 27th; discontinued Dec. 4th.	No result.
17	C. B.	16	Fair; rather anæmic; palpitations; dyspnœa on exertion.	Amenorrhœa 3 months, from cold, catamenia previously regular.	Commenced Nov. 29th; omitted after second application.	No result.
18	M. M.	15	General health not good; symptoms of hysteria; hereditary tendency to phthisis.	Never menstruated: has had pains at the monthly periods.	Commenced Dec. 19th; discontinued Jan. 15th.	No result.
19	J. C.	18	Fair complexion; brown hair; chlorotic; nutrition moderately good.	Never menstruated.	Duration of treatment not stated.	No result.
20	M. A. C.	16	Chlorotic; dyspnœa and palpitations on exertion.	Amenorrhœa 3 months; began to menstruate 9 months ago.	Catamenia reappeared 2 days after the use of electricity the third time.	At the next monthly period the catamenia were again absent.
21	L. M.	18	General health good; had a blow on the head 8 months ago, has been dull and stupid since.	Amenorrhœa since the blow, 8 months ago.	Commenced Sept. 24th; after 4 applications of electricity catamenia appeared and continued 4 days.	Cured.
22	Miss R.	18	General health much impared; mind depressed.	Duration of amenorrhœa several months.	Three weeks on first occasion; successfully repeated after 3 weeks, for 1 week with same result.	Cured.

The following cases may be selected from the table as good illustrations of the effects we may hope to obtain where electricity is applicable.

CASE LVI.—**Amenorrhœa.**—E. K——, aged 16, about the middle stature, has come to normal development, but has never menstruated; her general health is good, with the exception of slight gastrodynia and constipation; tongue clean, papillæ prominent.

January 30: Ordered:

Ext. aloes,
Ferri sulphatis,
Quininæ disulph., ... āā gr. i. ter die.

Shocks of electricity through the pelvis on alternate days. The catamenia appeared after the sixth application of the electricity on the 11th of February, and continued four days.

CASE LVII. **Amenorrhœa Suppressionis, Eight Months.**—L. M——, aged 18, general health good, rather chlorotic; had

a blow on the head eight months ago, since which she has been dull and stupid and the catamenia have been suppressed.

She was treated by various preparations of iron, aloes, hip baths, and other emmenagogue measures from the 23d of June to the 24th of September without effect, and electricity was now ordered. Shocks were passed through the pelvis every day and after the fourth time the catamenia returned, and lasted four days.

Case LVIII.—**Amenorrhœa Suppressionis, Eight Months.**—H. E——, aged 19, a healthy-looking young woman. Catamenia appeared first at the age of 17, and returned at irregular and short intervals. Altogether suppressed for the last eight months, since which she has suffered from confusion and oppression of the head. She has been under treatment with iron, aloes, hellebore, madder, etc., without effect. Shocks of electricity were begun the 22d of October, and repeated on alternate days. The catamenia appeared on the 2d of November, and continued three days.

Case LIX.—**Amenorrhœa Suppressionis, Nine Months.**—M. B——, aged 18, a stout, well-looking girl. Amenorrhœa for last nine months; previously the catamenia appeared at irregular intervals of five, six, or nine weeks. Under various treatment, including iron, aloes, etc., for six weeks before electricity was ordered. Shocks through the pelvis were employed on the 18th of October; on the morning of the 20th, the catamenia appeared and continued four days.

Case LX.—**Amenorrhœa Suppressionis.**—Miss R——, aged 18, rather tall; had been subject to amenorrhœa for a considerable time, for which she had been under the care of the late Mr. Callaway and Dr. Bright, and taken various preparations of iron, etc., without any benefit. My friend Dr. Lever then saw her. At that time her health was much deranged, with loss of appetite, irritability of nervous system, and dejection of mind; there was no sign of catamenia return. The preparations of iron with soda and rhubarb were again prescribed, and she left town for Brighton. Her health improved, but still the menstrual function was not restored. Electricity was now advised, and shocks were passed through the pelvis on alternate days, for three weeks, with good effect, the catamenia returning and lasting three days. The treatment was now omitted for three weeks, when it was again resumed for a week; and the catamenia reappeared at the end of that time for five days. The function has since been fully established. Her ge[illegible]l health

since this time has remarkably improved and she is now strong and well nourished.

I regret that, from an omission at the time the cases were entered in the books I have not been able in every instance to give the names of the physicians and the surgeons under whom they were. I would, however, add that all my colleagues have sent cases from their several departments. I have not included the cases of amaurosis, this report having already reached an unusual length.

CHAPTER XV.

CASES TREATED BY DR. A. ARTHUIS, OF PARIS, IN 1872–73.

Epilepsy. Clinical history and cure by static electricity. Paralysis with aphasia. A remarkable clinical history. Physiological action of the static current in recent apoplexy. Locomotor ataxia. Clinical history of a difficult case. Rheumatism. A clinical case. Contraction of muscles from fracture of the thigh. A case of rheumatism, general debility, and moral prostration. Treatment with static electricity successful.

I CLOSE this historical section with a series of cases reported by Dr. A. Arthuis, of Paris, in 1872–73.

Epilepsy.—The child which is the subject of this report was brought to us November 1st, 1871. His parents gave the following history: One day while his nurse was out walking with the child on her arm she accidently let it fall to the ground. The child, then not two years old, was greatly frightened. Was immediately seized with a cerebral trouble which was cured, but left in its wake an epileptic condition.

The convulsions became daily more frequent and more violent, and the case soon became one of extreme gravity. Not only did attacks present a more than ordinary violence, but they were repeated many times a day to such a degree that by their frequency and long duration they allowed scarcely more than a few hours' respite to the little patient. The physicians who treated the case prescribed the ordinary remedies, and especially belladonna. None of these succeeded, and the attacks were not lessened in frequency and intensity. In growing up, however, the crises gradually became less frequent, so that they occurred from two or three times a day to three or four times per week.

Meantime the right arm became atrophied and paralyzed, and the articulation of the wrist was distorted so that the palmar surface was turned outward and the dorsal surface inward. The whole arm was actually powerless and the child was unable to dress or feed itself.

This was the state when we first saw the case. the

age of twelve years. He had been epileptic for ten years and paralyzed in his right hand for eight years. During the night before coming to us he had two epileptic convulsions, which were violent and of long duration.

The day following these attacks we began our electrical treatment, being very careful to use gentle means. From that moment he has not had a convulsion. His constitution, very feeble, very anæmic, has also sensibly improved; the arm has developed and grown stronger daily; the hand has returned to its normal position. He can now do what he could never do before. He turns the knob of the door to open it, puts on his own gloves, takes and grasps firmly all sorts of objects. Finally he was able to devote himself to a laborious and difficult work, viz., turning a crank for two consecutive hours daily. He ceased treatment in just two months after commencing it. During this time there existed not a trace of epilepsy. We examined the case again six months later, and not a single attack had been experienced.

Paralysis with Aphasia.—Baron De B—— consulted us September 1st, 1871; aged 60 years, tall and large, of very sanguine temperament and of athletic physique. He was given a little to strong drinks and had indulged much in sexual pleasures. It was always immediately after excesses of this character that he had the three cerebral hemorrhages of which we now speak.

The first occurred in June, 1868. The patient remained several hours without consciousness. Then he experienced a general numbness which was very marked, but which disappeared after a few days' treatment. The second attack was a short time after, viz., in November of the same year. He showed the same symptoms as in the first attack, which again yielded to the remedies prescribed. The third attack, which was graver than the others, occurred a year later, in November, 1869. After this attack, despite the most active treatment, his health was much altered. Hemiplegia of the whole right side followed. Abolition of memory and speech supervened despite all means employed, chief of which were bleedings and frequent purgings. All the symptoms persisted, and when Baron De B—— came to us he was in the following state:

First, the right arm was without power, the right hand could not grasp anything, and for two years previously he had ceased not only to write, but even to sign his name.

Second, the right leg was much weaker than the other. The patient was unable to take even very short walks, and moreover, he required the aid of a cane or the arm of a friend. He for-

got every moment the things he knew best, and sought in vain to recall the names of even his most intimate friends.

Third and lastly, there was aphasia; his speech was very difficult, very hesitating; he always stammered, had the greatest difficulty in articulating the easiest words, and it was absolutely impossible for him to pronounce those which contained the letter *R*.

We began at once the electrical treatment of Baron De B——, Amelioration showed itself after the first few days, and the cure was very rapid. At the end of the twentieth electrization, he, who had not written his name for two years, wrote three letters, one after the other, of four pages each. He walked without a cane, and was not fatigued at all by a two hours' walk. Memory returned with equal rapidity. He recalled names, dates, and facts which had been forgotten a long time. Finally speech became less embarrassed. Improvement proceeded day by day, and on November 15th, two months after the beginning of treatment, he presented no trace of paralysis. All the side, arm, and leg were as vigorous as the other. The memory was also as clear and quick as before.

Speech alone left aught else to be desired. This symptom, however, remained sensitive to circumstances and conditions. When the weather was beautiful and dry and the patient had not experienced any emotion, speech was clear and perfectly normal, but when the weather was sombre, wet, and, above all (as often happens to him) the patient is in a passion, then his speech becomes a little hesitating.

"All authors," says Dr. Tripier, in his manual of electrotherapy, "agree in rejecting electrical treatment in encephalic paralysis so long as the lesion whence it proceeds is not on the road to repair, or even so long as the sum of possible reparation has not been fully attained." We admit that in these circumstances electrical excitation is without aim and not free from danger, that the excitation (carried inevitably to the sick part by sensitive nerves) solicits this part to react, and the constitution is thus in a condition which favors a return of the accident or its exaggeration. "Up to this time," says Dr. Tripier, "we have seen electricity applied to the treatment of paralysis of encephalic origin only as an empirical modifier of external symptoms. Will the action of electric currents upon

nutrition or their immediate chemical effects permit us some day to attack the central lesion and to favor the absorption of clots and the restoration of softened nerve substance?"

Static electricity has settled this question. *The electric fluid, as it is called, is above all things a regulator of the functions and a dispenser of equilibrium. It regulates the circulation (sanguinary as well as nervous), and it thus aids in the absorption of clots. Also, not only have we never had an accident in commencing treatment immediately after the hemorrhage, but the cure is much more certain and especially much more rapid than when the patient has waited many months.*

These few lines serve to show what an unfathomable abyss separates static from dynamic electricity.

Progressive Locomotor Ataxia.—The fatal term "progressive," which M. Duchenne gave to it ought not to belong to it to-day, since we are often able to arrest it in its invading march. We have treated a large number of ataxias and we are always successful in imposing a barrier to the disease. If all cases have not received a very great amelioration, it is solely because they have not had the patience to continue the treatment long enough. Two or three months are not long enough to triumph over a disease whose obstinacy has resisted every form of medication. We report the following case.

M. H. de la M——, aged 48, a man of letters, consulted us July 1st, 1872. The first symptoms of his disease which he could recall dated back twelve or fifteen years before consulting us. They consisted of fugitive intercostal pains, visual alterations with a marked tendency to strabismus and to diplopia. Under the influence of moral sufferings of a diverse nature his general condition was singularly aggravated. Sleep, appetite, and *embonpoint* had all successively disappeared.

He had consulted by turns many medical celebrities in Paris, who counselled a season at Ems (1866). The year afterward he was sent to Vichy, without obtaining the least benefit, and he returned suffering even more. The trouble was becoming worse. The shooting, intolerable pains became more and more frequent and partook of the nature of crises. The general wast-

ing increased, and he became incapable of intellectual work. The only prospect of life left to him caused a particular repugnance, and the mere idea of writing a few lines created extreme disgust. A hemorrhoidal condition now showed itself and with it a rebellious constipation and sensible weakening of the bladder. New consultations advised the waters of Aix (1868). The effect was little appreciable. Wintering in Paris was impossible, and he was ordered to Nice. Pains more and more lively, continuous emaciation, very great troubles of vision, incontinence of urine and the first disorders of locomotion were now present.

Turpentine vapors and baths were then prescribed, but at the twentieth bath were discontinued because of the debility of the patient and the inefficiency of the means. On returning to Paris a second season at Aix was recommended with no more result than the first. Then followed a new wintering at Nice, during which he took one hundred and four Turkish baths, accompanied by shampooing and frictions, which were not in the least curative, but which resulted in a certain sense of well-being. Returning to Paris he commenced galvanic treatment with a well-known specialist. He was treated daily for an hour with a voltaic pile of sixty elements, and every morning he treated himself, while yet in bed, with a pile of twelve elements. No appreciable benefit was obtained. Driven from Paris by the invasion he was unable to go beyond Orleans, where he became bedridden. He spent the winter of 1870–71 in the most distressing manner. His mind was clear, but his body was more and more affected. His walk became more difficult and disordered, and he fell down very frequently. The shooting pains attacked him almost daily and an implacable insomnia was a part of all his nights. At this moment he was so discouraged that he resisted all counsel for further medication and seemed resolved to abandon himself wholly to despair.

It was on the second of July that we began our electrical treatment. In about a month an amelioration manifested itself. A notable diminution of the pains, an increased appetite, and a better mental condition were present. At the end of the first year of our treatment his desire to work returned and he wrote and published a considerable amount of literary work.

We have now treated M. de M—— eighteen months, but the treatment has been many times interrupted. At intervals of about every six months we have advised the patient to rest for a month or less. The pains which heretofore were atrocious have wholly disappeared. Two or three times during the winter

he has had some returns of the pains, which have at once yielded when two or three electrifications were given at intervals of half an hour. His appetite is good. The *embonpoint* has returned, and the muscles are regaining their strength. Sensation in the limbs, which had been absolutely abolished, is entirely restored. Incontinence of urine does not exist at all, and his locomotion is better.

The equilibrium alone leaves more to be desired. But the immense results we have obtained, and which no other medication produced, leaves no doubt in our mind of the ultimate cure. One readily understands that it takes a long time to eradicate wholly a disease which dates back fifteen years. Most of the physicians who previously attended M. de M—— are themselves astonished at the benefit obtained and are the first to say to him: "*Patience and perseverance.*"

Rheumatism.—Rheumatic affections are essentially within the domain of static electro-therapeutics. It is indeed rare that they show themselves rebellious any length of time to this treatment. Daily are we obtaining complete cures, and we are always sure of obtaining an amelioration immediately. Our clinical observations are so abundant that we are only embarrassed for a choice.

M. G——, aged 58 years, of an extremely nervous temperament, was seized in June, 1871, with a muscular rheumatism of the left arm and shoulder. Seeing that the pains resisted the use of anodynes and frictions, his physician resorted to numerous flying blisters upon the shoulder and arm, and prescribed rest for the member. All these means did not lessen the pain, and three months afterward he came to us with the following symptoms:

First, extremely lively pain occupied all the muscular masses of the shoulder and the muscles of the left arm. The pains were increased to such an extent by the least pressure and by the slightest movement that he knew not in what position to put it to suffer the least.

Second, absolute impossibility to execute the least motion of the member. The pain had induced a sort of paralysis of the arm, so that the patient was neither able to extend it forward, nor lift it to his head, nor carry it behind his back. He was unable to dress himself, to draw on his overcoat, or do anything whatever.

Third, his mental state was one of excessive irritability.

We began treatment with static electricity the next day. As the patient was very irritable and the pains in the shoulder and arm were extremely severe, and the blisters continued to suppurate (so much so that his physicians had sought by various means for a long time to heal them), we were obliged to employ the gentlest procedures, and to lay aside sparks. The simple electrification and breeze were almost the only methods employed. Nevertheless, in two months only he was cured. The rheumatic pains were dispersed, the arm had recovered all its movements, and finally the temperament was favorably modified so that he was much less nervous and less impressionable.

Contraction of Muscles.—Count D——, aged 40, suffered in 1851 (from a fall from his horse) a fracture of the lower third of his left thigh. For two months his limb was immobilized in a fracture box, and when consolidation was accomplished he found a shortening of about one inch. From that day till Count D—— came to consult me he presented the following symptoms:

First, contraction of the muscles of the posterior part of the thigh which prevented extension of the limb, giving to it a curved form with an anterior convexity.

Second, a pronounced lameness resulted from this contraction.

Third, paroxysmal pains, having their seat in the lower part of the thigh and upper part of foot; especially acute on the level with the articulation of the knee, and becoming extremely acute upon exposure to cold and dampness. This was the patient's state when he came to us February 1st, 1872. Owing to imprudences of the Count, the pains in his knees at that moment were very severe. He had been for four hours hunting in a pelting rain.

After two and a half months' treatment all symptoms disappeared and the patient was free from his pain and his infirmity.

Rheumatism, General Debility, Moral Prostration.—Col. T——, aged 59, presented the following state when he came under our care in October, 1871: Rheumatic pains in all his limbs and lower part of back, together with marked lameness. The pain was particularly severe in the upper extremities, especially on a level with the scapulo-humeral articulation. The movements of his arm were very painful, and the patient with the greatest difficulty could draw on his overcoat, or move his

arm upward and behind him. Second, his vision was materially weakened. He not only has to wear very strong glasses, but when he goes out in the street his eyes become red and lacry mose. Third, for about a year he has been subject to sadness, which takes away all his physical and moral energy.

After a month of our treatment he exclaimed, "I am wholly cured of all my infirmities, and I exaggerate nothing when I state that I believe I am twenty years younger, morally as well as physically."

CHAPTER XVI.

REPORT OF DR. ARTHUIS CONTINUED.

Hysteria and chorea. Static electricity in the treatment of neuralgia. Facial neuralgia of twenty years' duration cured by static electricity. Sciatica. A clinical case. Migraine. Gastralgia and nervous vomiting. A clinical history and results of treatment. Asthma. Satisfactory relief by static electrification. A clinical case. Melancholia. Deafness. A clinical case with results of treatment. Amaurosis. Treatment unsuccessful. Dysmenorrhœa. Gradual relief from static electrification. A clinical case. Pulmonary phthisis. Two clinical cases with marked improvement. The value of static electricity in convalescence from long sicknesses. Its value in sustaining the vital forces of the aged. Remarks by the author upon the foregoing report.

Hysteria. — Static electricity is incontestably the one treatment which agrees best with females who have attacks of "nerves"; who, in a word, suffer from hysteria. In all large cities, and in Paris especially, where an agitated, artificial life takes the place of natural existence, there are few women who are completely exempt. If, indeed, all do not have an irritable nervous system they all from time to time experience some nervous phenomena. The vaunted drugs and sedatives often mitigate, but rarely do they produce an ultimate cure, sometimes not even an amelioration; but by static treatment we calm the nervous phenomena, diminish the intensity and duration of crises, remove them farther and farther, and finally prevent their return. All women who are acquainted with it at all are the first to proclaim the success of this agent, which immediately relieves them. It is the best curative means for chorea.

Neuralgia. — Neuralgias due to the existence of an organic lesion, or to some tumor, cannot be cured except you remove

the cause which determines and perpetuates them; but when the neuralgia is essential, there is nothing so efficacious as static electricity, whatever the seat of the disorder may be. It is always successful with facial neuralgia, generally calms it in two applications, and by continuing it almost always triumphs over these atrocious pains which are often rebellious to all medication. We have cured facial neuralgias which had existed for more than twenty years, and which have rarely left the patient free from pain for a single day. Also rebellious intercostal neuralgias have vanished and disappeared even more promptly than neuralgias of the head.

Sciatica.—Mr. F——, troubled for six months with intense sciatica which essence of turpentine, vesications, all sorts of frictions, etc., failed to relieve. After three weeks' treatment with static electricity his pain ceased.

Migraine is soon overcome by continued electrification.

Gastralgia, Nervous Vomiting.—M. L——, aged 32, nervous temperament, consulted us December 1st, 1872. His difficulty dates back eight years. For six years previous it has not been continuous (sometimes the patient being free from it for two or three months), but for two years past it has not left him a moment of repose. He presented these symptoms: A feeling of weight in epigastrium, distention of stomach, aversion to nourishment (especially meat), and obstinate vomiting which compelled him to submit to a rigid diet; excessive acidity, with acid eructations, with very severe pains in his stomach, and insomnia. His physicians employed by turns purges, magnesia, asafœtida, valerian, belladonna, cuprum, iron, anodyne, and antispasmodic lotions, raw beef, charcoal, wet compress to the stomach, etc., with result *nil.* Finally he was ordered upon an exclusive milk diet which arrested the vomiting in eight or ten days, but the cramps persisted, and were only quieted by taking milk regularly at intervals of an hour and a half. He was invariably reminded of a longer lapse of time by the returning of the cramps. Even in the night he is obliged to rouse himself and assuage them by swallowing a cup of milk. This was his experience night and day. The vomiting having ceased under the milk diet, the patient tried by various devices to take other aliment, but immediately the

atrocious stomachic pains appeared and the food was rejected as before. When M. L—— came to consult us he had taken nothing for nine months but the diet we have indicated.

We began immediately the use of static electricity because of the essentially nervous nature of the disease; because also of its long standing and of the inefficacy of all ordinary remedies. From the fifth sitting a notable amelioration was manifest. The patient could lie down and sleep ten hours. Instead of being roused up in an hour or two by the habitual cramp he was not aroused until 7 A.M., and he had no pain in the stomach. On the very same day he could, while at his usual work, pass three and even four hours without taking any milk. Since then the amelioration is more and more pronounced. Only once or twice has he had the least pain in the night. Ten days after commencing our treatment we had him take a raw meat ball, followed immediately by a teaspoonful of charcoal. It was perfectly borne and at the end of twenty days he digested easily cutlet, beefsteak, etc. Finally at the end of a month of treatment M. L—— found himself cured and ceased to come. We have treated a number of similar maladies with success, but rarely has a cure been so rapid.

Asthma.—M. F——, secretary of one of the large Paris journals, 37 years old, has been suffering seven years. Has attacks of a truly astonishing intensity which return many times daily and the approach of evening always brings one of extreme violence. A few days ago he went home at ten o'clock to retire, when he was suddenly seized with an attack of severe suffocation, which did not terminate until two o'clock in the morning, at which hour he was finally able to disrobe and go to bed. He had tried everything in vain.

A few months ago he began static electricity and has since breathed more easily. Every morning an electrification of ten minutes procures for him during the whole day a well-being unknown for a long time. It has happened many times to this patient to be violently attacked while mounting the insulator. We have hastened to put the machine in motion, and the attack has been arrested as by enchantment. This experience has been repeated many times and we are persuaded that if asthmatic patients could always have at their disposal an electrical machine and could three or four times a day be electrified they would arrive at, if not a complete cure, at least a removal of many of the attacks and would signally modify their duration and violence.

Melancholia.—Under the name of physical and moral prostration is meant a morbid state characterized by a group of symptoms which often follow in the train of great grief, caused either by the death of a parent, child, or friend, or by the loss of money, etc., which makes the subjects sad, morose, and hypochondriacal. The appetite, sleep, and vital forces disappear, and the brain ceases to perform its functions. Who has not noticed patients the subject of these vague affections without a definite name slowly fading and wasting day by day? They have vainly used bitters and all the tonics to recuperate their strength, and narcotics against insomnia; but neither distractions nor journeys are able to overcome their insurmountable sadness. Subjected to static electricity these patients have always, and very rapidly, established in them a singular amelioration. With the awakening of the vital forces, good spirits, appetite, sleep, and *embonpoint* return, and they speedily feel as if they were many years younger.

Deafness.—Madame M—— came to consult us in January, 1872. She told us that in 1861, immediately after long and profound afflictions, she felt extremely violent neuralgic pains in the right side of her face which for many months nothing could relieve. One day while talking with a friend she perceived that the diseased side was contracted, but as it was only slightly painful no attention was paid to it. That evening she sat down as usual at table, but in carrying the spoon of soup to her mouth she observed that the fluid escaped, and that movement of the cheek and right side of the lips was abolished. Her husband observed, moreover, that the upper eyelid could not be lowered, so that the eye remained widely open. They immediately consulted a physician who recognized facial paralysis. Hearing upon the same side was at the time same completely extinguished. Her physician immediately began using galvanic electricity, but his method of applying it caused no benefit, and was cruelly painful, and had to be abandoned after the fifth treatment. Vesications to the face and to the neck, iodide of potash in large doses, and antispasmodics of all sorts, were employed without much result. When we saw Madame M—— she had for a long time stopped all treatment; and tonics had a little ameliorated her condition. The eye was no

longer open; but the orbicularis palpebrarum muscle contracted much more feebly than before. The cheek was always expressionless and mastication on the affected side was impossible. Above all, the most pronounced symptom was the deafness, which, far from being diminished, was more pronounced. She could hear no sound of the voice on the right side and was greatly inconvenienced by this infirmity.

We began our electrical treatment by being careful to use only the most gentle means, for this patient was very fearful, always remembering the suffering she had endured from the galvanism. When she became confident that no pain was to be feared we directed sparks to the interior of the ear, and relief was not tardy in showing itself. She began to hear loud sounds, then more and more feeble ones, then the tick of a watch, and at the end of two months the deafness, which dated back twelve years, had wholly disappeared.

Amaurosis.—We treated M. H——, aged 50 years, blind for forty-one years, being requested by a distinguished oculist of Paris to try the effect of static electricity. At the end of one month M. H—— affirmed that he could better discern day from night, but unhappily it was impossible for him to continue treatment, as he left the city. We have never cured a case of this affection.

Dysmenorrhœa.—Mrs. C——, aged 25, constitution good, married six years; has for a few years been very sick at her periods. The menses never appeared at the regular time. Sometimes they appeared twice in a month, sometimes they were two months retarded, and their appearance was always preceded for three or four days by the most violent pain in the uterine region, in the haunches, and upper part of the leg. For four years the patient has used all the remedies in such cases without success. She came to us April 10th, 1872. For two days she felt horrible pains in the lower abdomen, lumbar region, and thighs. These were prodromata of menstruation, which speedily appeared. The most careful examination detected no organic cause, and we were obliged to attribute the dysmenorrhœa to a nervous state plainly pronounced and dating back only three years, according to the history of the patient. Narcotics and antispasmodics having been administered many times and uselessly, we considered it hopeless to try other remedies, and we recommended static electricity.

The same day a sitting of ten minutes was given. The

pains were quieted, and when the patient returned on the following day she scarcely suffered. In the evening the flow appeared and ran its course. Electrical treatment was suspended during the four days of its duration, when treatment was repeated. The menses next appeared at their ordinary time and without suffering. To avoid a relapse Mrs. C—— persisted several months in the use of electricity during the eight days which preceded the menstrual epoch, and the discharge continued to appear regularly and painlessly. She very gradually suspended treatment and menstruation has always been regular ever since.

Pulmonary Phthisis.—Miss G——, aged 15, has grown very rapidly, limbs very slender, breast flat, sweats easily and often. Takes cold easily and has all the appearance of chloro-anæmia. Began menstruating at fourteen years. Was regular for six months when her menses ceased and symptoms of chlorosis appeared. Cod-liver oil, quinine, and preparations of iron were given without success. Menstruation did not reappear. We determined upon the daily use of static electricity to the young patient for eight or ten minutes. After one month's treatment the menses reappeared without difficulty, the appetite returned, neuralgia of the head disappeared, night sweats were suppressed, and a leucorrhœa which had been very abundant for six months and had greatly exhausted this young girl, ceased. After another month cure was complete and treatment ceased. Since that time we have frequently seen Miss G——. Her menstruation is regular, and her health leaves nothing to be desired. Vallet's pills and quinine which previously had been without the usual results, were very effective when used simultaneously with static treatment.

Mrs. D——, aged 35, for four years has had pulmonary phthisis. When the lady called upon us the disease was far advanced and both lungs were affected. For a year the patient had not left her bed, and had not menstruated for two years. The pulmonary lesions were so far advanced that it was evidently impossible to hope to cure her chest affection. The symptom which especially troubled this patient was hectic fever, which appeared every evening with extreme violence and was accompanied by abundant night sweats. We administered remedies, but without the least success.

We then thought of static electricity, which we have many times seen check hectic fever in the third stage of phthisis. Unfortunately Mrs. D—— had not been able to leave her bed

for a long time. Nevertheless, as she was very courageous, she was wrapped up in warm furs, borne to a carriage and brought to us, where she was electrified every day. Under the influence of electricity the appetite, sleep, and general strength returned, and after twenty-one electrifications the patient could easily go up and down stairs supported simply by the aid of a friend's arm. The most extraordinary effect was that at the end of two months menstruation returned, which produced a further amelioration in the pulmonary trouble.

In the **convalescence** which follows long sicknesses, such as typhoid fever, the vital forces and harmonious action of all the functions are speedily restored by simply static electricity. Thus it will be seen that electricity abridges the duration of the cure.

In **old people** the vital forces are lower and all the organs functionate indifferently and imperfectly. Static electricity agrees well, and in numbers of cases we have restored to old people the appetite, sleep, and physical energy which seemed to have left them forever.

Remarks.—These cases of Dr. Arthuis (1871–72) which I have just cited possess a peculiar interest at this point of our historical narrative.

The new introduction of "general" electrical treatment as distinguished from the "localized" methods of Duchenne (who almost exclusively used the faradic current) has been accredited to the revival of the static electricity in 1879 by Charcot, of Paris. But these cases here reproduced bear an earlier date. They mark the border line between the old and new, but they reaffirm the old and established teachings of the physiological action of static electricity. Arthuis omits always to state the method and frequency of his application, but from a perusal of his full account it appears that he employed positive electrification with the patient in direct metallic connection with the positive prime conductor, together with the breeze and sparks from a grounded electrode.

This completes the list of historical cases. That they are

well worth collecting together and reproducing here cannot be doubted; and when it is understood how much superior the modern machine is to the old, it will be needless to argue further that static electricity is to-day in skilful hands, and with our advance in the comprehension of the nature of disease, capable of far better therapeutic work than it performed even in the period of its "golden age."

The best part of its career in medicine lies before it, and it is destined to serve the coming generation better than it served the times of Wesley, Franklin, and Golding Bird, when it was at best but a feeble instrument, inconvenient and often uncertain in action, and weighed down by drawbacks which finally caused it to be abandoned. Most of these disadvantages have now been removed, and static electricity has found a large number of conscientious operators who express the highest appreciation of its merits.

It may reasonably be asked: "How could these older electricians, with their inferior machines, obtain results which would leave little to be desired to-day?" There are ways to explain this seeming paradox which do not require us to fall back upon the assumption that these old reports are unreliable. It is not worth while to question the veracity of men like Franklin, Wesley, Addison, Bird, Gull, and others whose names are everywhere honored throughout the world. We must consider that the old reports are as fairly entitled to belief as any recently reported cases would be. An explanation which reconciles the apparent discrepancy is accordingly offered.

First, the old "electrical rooms" in which the machines were operated appear to have been thoroughly warmed and dried by a fire. This would prevent wasteful dissipation of the current and develop the full capacity of the machine.

Second, the patient appears to have always been placed in direct metallic connection with the prime conductor. This alone would serve to concentrate the current sufficiently to offset a great part of the difference between a feeble machine thus

used and a powerful one often employed, as now, with the co ducting rod at an opposite end of the platform.

Third, although the Ramsden and similar machines produc but a small spark and breeze in proportion to a Holtz apparatu yet the older electricians compensated for this disparity in tv ways. They were accustomed to apply the spark under tl most favorable conditions. Moreover, when the spark lacke strength they used the "Leyden-jar shock." We have di carded the Leyden-jar shocks, because the increased power o our large machines has now made them unnecessary, and w get along very well without them. Our thick, strong spark take their place to far better advantage. This simple fact not generally recognized, but it shows that if their ordinar spark was feeble compared with the thick strong spark to whic we are accustomed, they did not lack means sufficiently ener getic for many practical purposes.

Fourth, ingenious men, working with poor tools, will ofte develop in them extraordinary capabilities. Such exploits a those of Baron Trenck bear witness to what men can do wit crude implements when they have no better. From a "littl field well tilled" a thrifty gardener will often profit more tha a large ranchman on the prairies who is prodigal of his lanc Our great modern machines are often, in fact usually, ver wastefully employed, so that the net difference to the patient i not so great as would at first sight seem to appear. (Author.)

CHAPTER XVII.

THE MORAL EFFECT OF THE STATIC MACHINE CONSIDERED AS A MEDICAL APPARATUS.

It is occasionally alleged by some theoretical therapeutist that the static machine makes a great impression upon a patient, produces a powerful moral effect, and acts chiefly by suggestion. Even in former years those who denied to static electricity any but a mere surface effect upon disease professed to believe that it acted very deeply upon the imagination. The author has frequently conversed with practitioners who were considering the purchase of a Holtz machine and one of the strongest motives that seemed to urge them to buy was the belief that with such an instrument they could impress their clientèle.

Roentgen's remarkable discovery, and the substitution of a practical interest in X rays and electricity for former ignorance, is rapidly clearing the atmosphere of the misty errors about this branch of medicine long perpetuated in modern works. In the quiescent period of electrical discovery between the immortal Faraday and the immortal though living Edison, it seemed to be taken for granted that the few static machines then in rare and occasional use exerted an important part of their effects through the medium of the indefinite and unreal.

One of our leading medical journals published with approval on April 6th, 1889, an editorial paragraph previously published February 26th, 1887, stating that: "It is perhaps through the psychic that electricity acts in the majority of cases." This curious statement is handed down for generation after generation through a succession of "medical dictionaries" and "reference books of practical therapeutics." One such elaborate work in

two large volumes is now fresh from the publisher's hand and was shown the author but yesterday. The intelligent canvasser with the born instinct of a salesman called my attention to the fact that it treated of electricity. It did. It treated of electricity as the dark and mediæval ages of science treated of chemistry. "Electricity, its indications, effects, and methods of application" were set forth in the prospectus as "quite as much to be studied by the medical practitioner as drugs properly so-called, for they constitute a large part of the resources with which he seeks to prevent disease, or conduct it to a happy issue." The short and condensed chapter then proceeded to repeat the stock errors of a long line of similar works written by men who seem never to have got close enough to a scientific electrical apparatus to touch it. Where the chapter did not perpetuate old errors of ignorance it repeated old errors of facts. It put the fresh stamp of 1897 and the trade-mark of one of the most prominent publishing houses in the United States upon a piece of space writing that would have been in great part obsolete forty years ago. Doctors get wrong ideas about electricity from such books, and publishers unintentionally do great injustice to a great curative agent.

To return to the static machine: It is indeed impressive and even magnificent, when displayed, especially in a darkened room, by a skilful exhibitor of its luminous glows, sparks, and brush discharges.

Its radiant brush between the sliding poles is one of extraordinary beauty and impresses the eye, while the loud report of a ten-inch spark from large Leyden jars can easily make too great an impression on the ears for comfort. But however magnificent this may be it is not "therapeutics," nor is it exhibited to clinical patients. To the majority of individuals who consult a physician the static machine is a *terra incognita*, and their first sight of it is generally coincident with their first treatment.

The impressions produced by the appearance of the machine

will be found to be as various as the temperament of different patients. A limited number of well-informed and sensible patients will proceed to follow instructions unquestioningly and accept treatment without remark. Some will require a brief assurance that it will not "hurt"; but as a rule it is the dominant influence of the physician himself and his mastery over the patient's confidence that controls the situation, rather than any moral persuasiveness on the part of the machine at first.

It is, in fact, more liable to inspire other feelings in a neurasthenic stranger than simple-minded awe, and its "impressiveness" may at first occasionally take the form of a drawback. It is unfortunate and regrettable that a benign medicinal agent, potent for good and far removed from evil intent, should suffer in the general estimation from the needless but almost universal idea that electrical treatment is synonymous with shocks.

At present *shocks*, as the term is now understood, bear a similar remote relationship to scientific electro-therapeutics that collisions bear to regular railway travel; with the important exception that an engineer cannot always avoid a collision, while a careful electrician will very rarely give a patient a shock, and if a shock accidentally occurs it is perfectly harmless. In static application, however, the term is applied to the Leyden-jar discharge, formerly employed to a considerable extent in the days of small and less powerful machines than we possess now.

It is not necessary to describe the method of giving them, as for all practical purposes they may be considered obsolete. They were relied upon in early days because a small machine would fill a Leyden jar, while it would not supply a current flow sufficient for every use. The electricians of the eighteenth century were, however, close observers, and as early as 1781 Cavallo made the following remarks: "Formerly, in order to stimulate or in general to apply electricity to any diseased part of the human body, strong shocks, or at least very pungent sparks, were thought necessary; but at present it is very reasonably established by experience that the greatest electric powers

which can be applied with good expectations are exceedingly small shocks and moderate sparks, but that in general the most proper treatment is to throw the fluid by means of a wooden or metallic point, in which last case the person electrified feels only a gentle wind upon that part of the body toward which the point is directed."

Here, however, with the first introduction of a patient to a static machine ends our need of contention as to the error in regard to its moral effects. Once past the initiatory timidity, there is seldom any need for further remark on this point. It seems to me that nothing in therapeutics is more definitely capable of demonstration than the beneficent action of the static current. I know of no remedy that leaves so little room for the play of the imagination, or that carries such certain conviction of benefit to a patient's mind.

To Charcot is due the credit of demonstrating the efficacy of "suggestion" in certain cases, but suggestion cannot for a moment dispute the clear title of static electricity to its own laurels. Patients undergoing electrical treatment with apparent benefit are quite liable to be told by officious friends that the benefit is chiefly due to their imagination; but if any curative agent exists which is absolutely independent of imaginary claims for recognition that agent is static electricity.

The therapeutic work it will do and repeat, and repeat again with celerity, thoroughness, and unfailing definiteness of action we cannot succeed in duplicating by any other means at our command. Nor are we aware of any other medicinal agent employed against disease which will accomplish as definite a result in so short a time, and which is so frequently lasting in its effects.

No drug is prescribed without particular regard to its indications, its dosage, its form, and frequency of administration, and to neglect these details is to court failure. Even at best physicians are not seldom disappointed in the action of drug remedies and are sometimes baffled by encountering peculiar

idiosyncrasies against carefully selected drugs. If we exercise the same care in prescribing and applying static electricity, and make a not less liberal allowance for the existence of idiosyncrasies, we shall be seldom disappointed in the remedy we employ. Writers frequently state, in regard to the static breeze, that they know of no form of electrical treatment which elicits such expressions of appreciation as does this. I agree with them, but as evidence that the static breeze does not act through the medium of suggestion it may equally be said that no form of electrical treatment can be made less effective or more atrocious and distasteful to the patient. If this is done by an unskilful hand, we should not unjustly condemn the instrument he uses but simply advise him to be instructed better.

Many elements enter into the sum-total of satisfactory administrations, and call for tactful management in handling the electrode.

Not the least of the occasions for careful management is to be found in the patient's clothing. Both its material and texture have much to do with the sensations and effects of the useful static spray. In fact the mere differences in the actual sensation and direct effect of various forms of static applications given under differing conditions go far to refute the plea that it acts by suggestion and through the imagination. Laying aside this form of argument, however, and going at once to the root of the matter, let us place the advocate of the imagination theory upon the static platform, blindfold his eyes, and treat him to several gentle sparks, or apply to his spine a powerful counter-irritant spray. The fact is demonstrable that static applications convince wherever they are applied, and no argument or process of ratiocination can prevail against them.

It might be admitted for the sake of theory that a cure produced by suggestion or by moral effect is as good as a cure wrought by quinine, for the mission of a doctor is to cure his patients if he can. Patients coming to the physician's office do not usually express a predetermined choice of the means by

which they will accept relief. It is the custom of most practitioners to employ all means at their command which they think will cure, and if there is anything about the administration of any form of electricity which produces a favorable effect upon the patient's mind, and in the slightest degree assists to promote a cure, I am inclined to believe that this gives this agent an advantage which is entirely to its credit and does not in the slightest degree constitute any argument against it.

X-RAY APPENDIX.

One of the features of the months since the first edition of this book was published has been a continued and increasing interest in X-ray work, which is perhaps accounted for by the fact that large numbers of physicians who have remained indifferent for more than a year are now appreciating the practical importance of the subject. No physician who once witnesses a high efficiency X-ray demonstration can fail to desire so valuable a resource.

Observations upon fractures by the aid of the X ray have led surgeons to state that a new treatise on fractures and dislocations will have to be written, based on the revelations of the fluoroscope and the X-ray photograph. In the examination of soft parts very much more can be accomplished to-day than when I previously wrote. The improved fluoroscope now furnishes much sharper definition and enables us to discern within the chest much that was before obscure. Among important contributions to the subject is one of especial interest by Dr. J. E. Stubbert, from which the following is taken:

Comparative Diagnosis in Pulmonary Tuberculosis by the Roentgen Rays.*—The following cases are presented for the purpose of demonstrating that in the Roentgen rays and fluoroscope we possess accurate agents for diagnosing tuberculous changes of lung tissue in its various stages, using them not only as corroborative factors of results arrived at by auscultation and percussion, but in some instances discovering isolated foci of infection not recognizable by ordinary methods.

In addition these cases prove that the fluoroscope enables us to recognize more fully and accurately the degree, position, and relation of areas of infiltration and consolidation, and also delineates plainly the limits of these areas.

* Medical Record, May 22d, 1897.

In order that these observations might be of more value, the examinations have been made by different physicians, and written notes thereof taken by different nurses to obviate all danger of bias due to familiarity with the results of examination by the ordinary method before using the fluoroscope, and *vice versa*. In addition, laymen have been requested to look into the fluoroscope and report the relative intensity of the transmitted light in different regions. Pencil marks were made by their direction, and they have invariably coincided with the professional examinations.

By reference to the following table it will be seen that in Cases X., XIV., and XLV. there was simply haziness of the infiltrated areas and, in some incipient cases, at the apex. The first thing that is noticed may be a comparative haziness or indistinctness of outline of the clavicle on the affected side.

In cases of slight infiltration of one or two apices there is a haziness or fog between the light and the observer, the clavicle in other instances appearing to have a gauzy veil thrown over it.

When there is marked consolidation the transmitted light is relatively less, the edges of the clavicle are indistinct, or the bone may be invisible. When there is present the same pathological condition at both apices it is an easy matter, by comparing the two sides, at once to decide upon which the disease has made the most progress.

Comparative shadows at the apices are generally seen more distinctly from behind than in front, by directing the patient to bring his shoulders forward so as to separate as widely as possible the scapulæ, and then placing the fluoroscope directly over the spinal column.

Ordinarily a practised eye can, by these methods alone, clearly distinguish areas of the most incipient infiltration; but if it is desired to be more accurate in defining their limits, a metal rod may be placed evenly against the chest walls in front or behind, and moved up and down with the fluoroscope until its outline becomes more distinct, which will indicate that the upper and lower borders of the consolidation have been reached.

If a pencil mark now be made along the edge of the rods and subsequently percussion practised, the area of dulness will be found between the lines.

In cases of complete dulness, say to the second interspace, with relatively less dulness for one or two interspaces below, a dark shadow will be seen over the first-named region, which will gradually shade off consecutively into haziness and normal

reflex of light below, the area of haziness corresponding to the limits of relative dulness. In one or two instances slight haziness has been observed in spots which at the time showed no other physical signs of disease, but where they subsequently developed.

One case, number XXXI., is a good illustration of the appearance of a lung in which cavities exist. In cases in which the cavity is single, it appears as a bright reflex amidst an area of consolidation or shadow. This bright spot assumes the shape of the cavity. At times the observer can plainly discern a decidedly dark ring surrounding the dark spot (see case number XI.).

In Case XXVI. in which there were multiple cavities, the dense intervening tissue was shown in the form of dark streaks winding between the spots of bright reflex.

In another case, number II., the fluoroscope demonstrated a cavity which had presented no signs by percussion or auscultation, probably owing to obstruction at its outlet.

In Cases LXXII. and LXV., old pleuritic adhesions were seen as areas of absolute darkness, even more dense than the normal shadow over the cardiac region. In Case LXIX., displacement of the heart downward and to the right was easily marked out, also an old pleuritic thickening. Cardiac dilatation was discovered in one case. When I state that the exact areas in these last two cases were marked out by my house physician, without any knowledge of my previous diagnosis, the value and exactness of the fluoroscope as a diagnostic agent is well authenticated.

At different times we have outlined the convexity of the arch of the liver, which can be seen to rise and fall with expiration and inspiration. The cardiac pulsations are easily discernible.

A series of fifteen healthy cases was examined in order to familiarize the observer with normal reflexes and shadows.

A summary of the result of our investigations at the sanitarium shows:

1. Slight haziness indicates the beginning of tuberculous infiltration, and may or may not be accompanied by dulness.

2. Decided shadows indicate consolidation, the extent of which is in direct relation to the comparative density of the shadow thrown on the fluoroscope.

3. Circumscribed spots of bright reflex, surrounded by narrow dark shadow rings or located in the midst of an area of dense shadow, indicate cavities.

4. Intense darkness, especially at the lower portion of the

lung, indicates old pleuritic thickenings over consolidated lung tissue.

A great deal depends upon the intensity and steadiness of the light. Considerable practice is necessary before the eye can appreciate perfectly the finer differences of shades and outlines.

At the sanitarium the examination of patients by the X-ray is now as much a matter of routine as that by auscultation and percussion.

CASE I. Physical Examination.*—Dulness left side infraclavicular space. Slight increase vocal resonance left side to fourth interspace.

Fluoroscopic Examination.—Shadow over left upper lobe anteriorly to fourth interspace. To midline of scapula posteriorly.

CASE II. P. E.—Consolidation right lung with crepitant râles anteriorly and posteriorly. Circumscribed area of increased vocal resonance third interspace near sternum right side.

F. E.—Shadow from third interspace to base of lung. Extending from first interspace to third rib one inch from sternum, a bright light surrounded by dark ring.

CASE III. P. E.—Consolidation right upper lobe. Crepitant and subcrepitant râles.

F. E.—Sharply defined shadow right upper lobe. Ribs sharply defined until shadow is reached.

CASE IV. P. E.—Right apex to third interspace, dulness, crepitant râles, and increased vocal resonance. Occasional crepitant râle base of right lung.

F. E.—Shadow right apex to third interspace. Slight shadow base of right lung.

CASE V. P. E.—Slight infiltration left side.

F. E.—Shadow left side January 29th, 1897. Absolutely clear February 26th, 1897.

CASE VI. P. E.—Infiltration right upper lobe. Crepitant and subcrepitant râles to second interspace.

F. E.—Shadow to third interspace right side.

CASE VIII. P. E.—Dulness right side to second interspace near edge of sternum. Increased vocal resonance, pleuritic friction sounds, broncho-vesicular breathing right side to third interspace.

F. E.—Wedge-shaped shadow right side second interspace near border of sternum.

CASE XI. P. E.—First stage affecting right lung. Second stage affecting left lung with physical signs of cavity in fourth interspace.

F. E.—Shadow to fourth interspace left side. At fourth interspace a circumscribed area of light surrounded by dark ring. Shadow right side to third interspace.

CASE XIII. P. E.—Consolidation right upper lobe. Dulness, increased vocal resonance, crepitant and subcrepitant râles right side to third interspace.

* Of the seventy-three cases reported it is sufficient to cite here a few which illustrate the series.

F. E.—Shadow to third interspace right side anteriorly and to lower angle of scapula posteriorly.

CASE XVI. P. E.—Slight dulness right side anteriorly to second interspace, to midline scapula posteriorly. Exaggerated breathing and increased vocal resonance same region.

F. E.—Slight shadow right side to second interspace.

CASE XVII. P. E.—Dulness right upper lobe, bronchial breathing, increased vocal resonance whole right lung.

F. E—Whole right lung casts a shadow. More marked to third interspace.

CASE XXIV. P. E.—Dulness, increased vocal resonance, and crepitant râles over entire left lung.

F. E.—Left side dark with good reflex above and below clavicle. Right side clear with good reflex.

CASE XXVI. P. E.—Dulness, increased vocal resonance left side, apex to fifth rib. Cracked-pot resonance second interspace left side, mucous and crepitant râles.

F. E.—A circumscribed area of light surrounded by dark ring in second interspace, left side. Lung dark to fourth interspace.

CASE XXX. P. E.—Decided dulness right side to third interspace. Cracked-pot resonance second interspace right side. Relative dulness whole right lung.

F. E.—Shadow whole right lung, more marked at apex. Bright spot second and third interspace. Left lung negative.

CASE XXXI. P. E.—Dulness right infraclavicular space. Increased vocal resonance, amphoric breathing, and cracked-pot resonance to fourth interspace right side.

F. E.—Shadow to fourth interspace right side. Bright spots second interspace right side, surrounded by dark ring.

CASE XXXII. P. E.—Increased vocal resonance apex and infraclavicular space. Diminished respiration murmur, cog-wheel respiration right side to second interspace. Crepitant râles right apex.

F. E.—Decided shadow right apex to third interspace.

CASE XXXIII. P. E.—Dulness left lung to fifth interspace. Slight crepitation with pleuritic friction sounds left apex posteriorly.

F. E.—Shadow from left apex to fourth interspace. Shadow more marked at apex.

CASE XXXIV. P. E.—Dulness, bronchial respiration, increased vocal resonance right apex and infraclavicular space.

F. E.—Shadow right apex to second interspace.

CASE XXXV. P. E.—Dulness both apices. Increased vocal resonance to second interspaces. Crepitant râles to second interspaces both apices.

F. E.—Shadow to third interspace right side anteriorly and midline scapula posteriorly. To second interspace left side anteriorly and upper angle scapula posteriorly.

CASE XL. P. E.—Increased vocal resonance right upper lobe to second interspace. Relative dulness to third interspace.

F. E.—Shadow to second interspace right side anteriorly and upper angle of scapula posteriorly.

CASE XLII. P. E.—Dulness left side to second interspace. Increased vocal resonance and bronchial breathing with pleuritic friction sounds over right lung.

F. E.—Shadow left side to third interspace. Right lung slightly hazy.

CASE XLIII. P. E.—Dulness both apices. Broncho-vesicular respiration right side.

F. E.—Shadow both apices, more pronounced on right side.

CASE XLV. P. E.—Slight dulness, prolonged expiration, and increased vocal resonance right apex to second interspace.

F. E.—Very slight shadow right apex to second interspace.

CASE XLVI. P. E.—Dulness, increased vocal resonance, pleuritic friction sounds, broncho-vesicular respiration, and prolonged expiration left side to fourth interspace. Slight dulness right apex to second interspace.

F. E.—Shadow left upper lobe to fourth interspace. Shadow right upper lobe to second interspace.

CASE XLVIII. P. E.—Slight dulness and increased vocal resonance right apex and infraclavicular space.

F. E.—Slight shadow right apex to second interspace.

CASE XLIX. P. E.—Dulness right infraclavicular space. Slight crepitation right infraclavicular space anteriorly.

F. E.—Slight shadow right upper lobe to second interspace anteriorly. To midline of scapula posteriorly.

CASE L. P. E.—Dulness, increased vocal resonance, and crepitant râles left upper lobe.

F. E.—Distinct shadow to second interspace left side anteriorly. To midline posteriorly.

CASE LII. P. E.—Dulness first interspace. Sibilant râles upper angle of scapula. Pleuritic friction sounds right side posteriorly. Increased vocal resonance left side anteriorly; crepitant râles anteriorly to third interspace.

F. E.—Shadow right apex; left side shadow to third interspace anteriorly and midline of scapula posteriorly.

CASE LVII. P. E.—Dulness right side and in infraclavicular space and first interspace left side. Both lungs dull posteriorly, right side more so. Increased vocal resonance right side. Crepitant râles right apex. Bronchophony crepitant râles, and semiliquid râles right side opposite spine of scapula.

F. E.—Right apex nearly opaque. Whole of right lung very dark. Light spot in second and third interspace right side. Shadow left side down to second interspace.

CASE LX. P. E.—Dulness both apices. Increased vocal resonance and cog-wheel respiration both upper lobes.

F. E.—Shadow right apex to second interspace. Shadow to second interspace left side.

CASE LXI. P. E.—Dulness, increased vocal resonance. Rude bronchial respiration with jerky respiration right side to nipple. Dulness, bronchial respiration, rude in character, left side to third rib.

F. E.—Right side distinct shadow to nipple. Left side shadow distinct to third rib, remainder of lung hazy.

CASE LXIII. P. E.—Dulness, cog-wheel respiration, increased vocal resonance, broncho-vesicular respiration right side to third interspace. Dulness, increased vocal resonance, and bronchial breathing left side to third rib.

F. E.—Shadow right side to third rib. Hazy to third interspace left side. Shadow right and left to midline of scapula.

CASE LXV. P. E.—Dulness, increased vocal resonance, crepitant and subcrepitant râles, prolonged expiration, right side to third interspace. Dulness, increased vocal resonance, crepitant râles, bronchial breathing, left side to second interspace. Broncho-vesicular breathing in third and fourth interspaces left side.

F. E.—Shadow both apices, to second interspace left side, to third interspace right side. Shadow opposite heart fourth interspace almost identical with cardiac shadow.

CASE LXVII. P. E.—Increased vocal resonance right apex to second interspace. Increased vocal fremitus, dulness, increased vocal resonance, crepitant râles, and broncho-vesicular breathing left side.

F. E.—Shadow right side to second interspace, more marked above clavicle anteriorly. Shadow outer half left lung shading to haziness toward sternum. Line of shadow distinct below fourth interspace.

CASE LXIX. P. E.—Increased vocal resonance, dulness right side to third rib. Pleuritic friction sounds, suppressed respiratory murmur fourth interspace to base of lung. History shows an old attack of pneumothorax with effusion left side, with hypertrophy of the heart to the right.

F. E.—Shadow right apex to third rib. Shadow left side fourth interspace to base of lung (pleuritic thickening). Heart hypertrophied to the right in line with and one inch above right nipple. Apex beat in fourth interspace border of sternum. Slight haziness right side to nipple, more marked at apex.

CASE LXX. P. E.—Dulness to nipple, crepitant râles and pleuritic friction sounds apex to base right side. Crepitant and sonorous râles, pleuritic friction sounds left side to third rib.

F. E.—Shadow from apex to base right lung. Shadow left side to third interspace.

CASE LXXI. P. E.—Dulness, increased vocal resonance, crepitant râles right side to third rib.

F. E.—Shadow right side to second interspace anteriorly and midline of scapula posteriorly.

CASE LXXII. P. E.—Increased vocal resonance, dulness apex to second interspace right ride.

F. E.—Shadow right side apex to second interspace. Shadow nipple to base of lung right side.

CASE LXXIII. P. E.—Dulness to third interspace anteriorly to upper angle scapula posteriorly right side. Marked vesicular tympanitic resonance first interspace, cracked-pot resonance infraclavicular space right side. Whisper resonance right apex to upper angle of scapula posteriorly right side with amphoric breathing. Increased vocal resonance, crepitant râles at spine of scapula to base of lung right side.

F. E.—Circumscribed area of light surrounded by dark ring, first interspace right side. Remainder of lung hazy.

A Study of Maximum X-Ray Effects with the Static Machine.—In the author's article upon "Crookes Tubes and Static Machines," cited on page 111 of this book, no attempt

was made to consider maximum effects, and the results then spoken of can now be obtained by any physician employing the static apparatus as I described. It is of interest, however, to consider what are the present ultra-ordinary effects at the disposition of the surgeon who seeks to locate promptly a bullet in the skull, thorax, or pelvis, or to make an instantaneous examination into any of the larger joints and deeper structures of the body.

It is becoming more and more manifest that beyond the ordinary X-radiance which suffices for examinations of the small joints and thinner portions of the body, there is an urgent demand for facilities to invade with the eye and the fluoroscope all the different opacities which the human trunk presents. All physicians now recognize this fact, and eagerly inquire what can be done in this respect. I shall here set forth the notes of some recent experiments.

In testing a large number of tubes which have been made according to my suggestion and which physicians can now readily obtain, I have observed the following effects under favorable conditions and have demonstrated them to those who have consulted me for instructions in X-ray work.

Conditions.—1. A completely darkened room, daylight and gaslight excluded, and the eyes reasonably guarded from the bright glow of the tube, so as to prepare them for the differentiation of dim shadows.

2. A competent fluoroscope. That used by me at present is one of the improved barium-platino-cyanide screens recently introduced.

3. A high-efficiency Crookes tube developed to its maximum of X-ray generation.

4. An eight-plate Holtz machine producing its maximum current.

5. A pair of the author's improved interrupters correctly adjusted to suit a given tube and current.

Tests.—My test piece is a strip of half-inch pine board

backed with assorted metallic objects of various sizes, from a small point to a medium-sized key, and wound with a dozen spirals of fine copper wire.

The shadow of the key is visible through the board at a distance of thirty-six feet from the tube; at fifteen feet the small objects and fine wires show plain definition; at five feet the board is like thin porcelain held in front of an incandescent lamp, and at six inches the test piece appears almost in a glow of light.

Placing Webster's Unabridged Dictionary and two volumes of encyclopædia six inches in front of the tube, I have an ag-

Fluoroscope.

gregate of thirty-six hundred pages of paper plus six heavy board covers, through which the objects upon the test piece against the screen are clearly defined to the eye. Through a metal foot-plate electrode, composed of two heavy layers of sheet copper one inch apart, the objects on the test piece are visible twelve to twenty inches from the tube.

The mechanism of the hand, wrist, arm, ankle, and all small and thin parts appears upon the screen three feet from the tube. Between the distance of thirty-six and twelve inches from the tube all gradations of transparency such as the surgeon may require for these parts are secured. When the object is nearer than twelve inches the bones become sufficiently transparent to

allow the ready detection of a broken needle embedded in the radius or ulna, or bones of the hand—one of the most difficult of foreign bodies to locate with the fluoroscope.

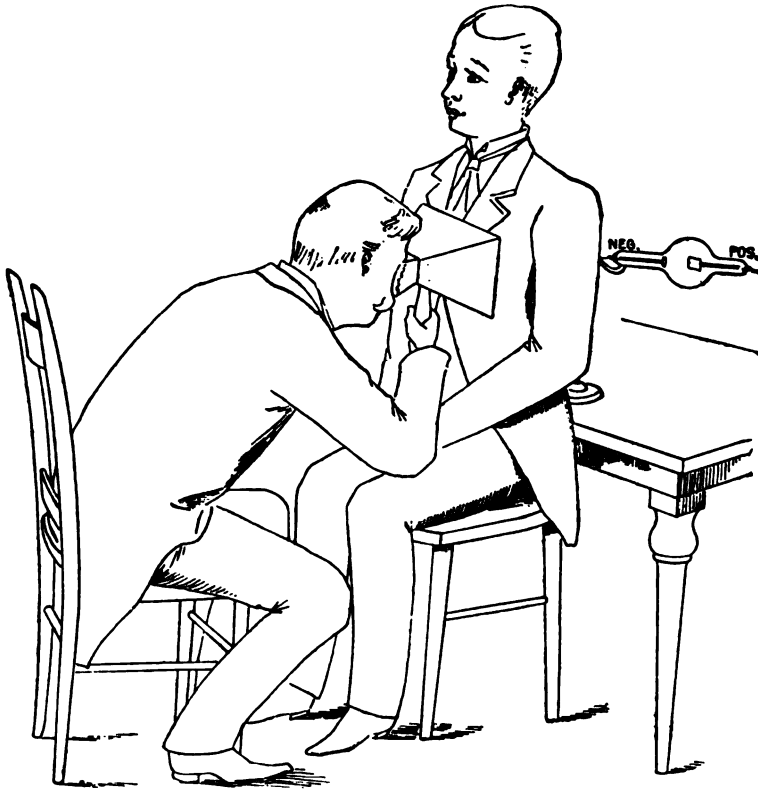
The shoulder- and knee-joints are quite distantly shadowed at three feet from the tube, and the increase in transparency up to six inches is adequate for full surgical examination.

The head of a grown person viewed through the screen from side to side at all distances, from three feet down to four inches between the tube bulb and the ear, shows increasing transparency, until not only the lighter portions—frontal sinus, antrum, nose, etc.—are penetrated, but any small metallic object placed opposite the thickest part is plainly seen whenever it is moved, showing that a bullet anywhere in the head could be quickly located with ease. At the maximum of radiance the transparency of the skull is about equal to the transparency of the hand as exhibited to me by operators employing tubes of ordinary efficiency with medium-coil currents.

The spinal column and osseous details of the trunk are visible in clear outline, and may be studied in different degrees of transparency at all distances up to three feet. The detection of a bullet, fracture, or dislocation by the fluoroscope in even the densest parts of the body is thus assured by these rays.

At between three and four feet from the tube the heart of an ordinary man is seen in nearly normal position and size. In a man of spare build it is as plainly seen, in as sharp detail and exact definition, as would be a pear or acorn held behind the fluoroscope. The heart shadow is magnified (as are all other objects) when inspections close to the tube are required by low-efficiency apparatus, but when thirty or forty inches may intervene between the eye and the reflector the mass of the heart stands out in clear and undistorted relief upon the fluorescing screen. The *Medical Record* of April 10th contains an article upon "Fluorography for Determining the Position, Size, and Movements of the Heart." It describes quite a complicated and uncertain process of mapping or tracing the heart outline

—a process which consumes, it is said, about fifteen minutes' time with an expert, and can hardly be accomplished at all in many subjects. I would like to quote the technique in full, but it fills seventy lines of the *Record* and space forbids. With



The above diagram illustrates the position of tube, subject, and operator, in making a fluoroscopic examination of the heart. The fluoroscope may be shifted to any portion of the trunk. Have the patient move forward or back until the best view is obtained. A dark room is of course necessary for the best view.

a high-efficiency tube my own technique consists in sitting the patient on a stool a couple of feet in front of the tube, with the screen over the heart anteriorly. I then sit down and look into the fluoroscope, while the patient shifts forward until the heart

shadow is most distinct. That is all there is to it. As the whole outline is clear-cut and sharp, there is no need of tracing paper, the draughtsman's art, or the delay of the fluorographic method, so interestingly reported as the outcome of a month of experiment and study. I do not need to "map out the heart with a tracing pencil," for I can *see* it with sufficient plainness in almost every subject examined, but the recent discussion before the Academy of Medicine illustrates the difficulties against which operators without high-efficiency apparatus have been earnestly contending in their enthusiastic desire to harness the X ray to important medical uses.

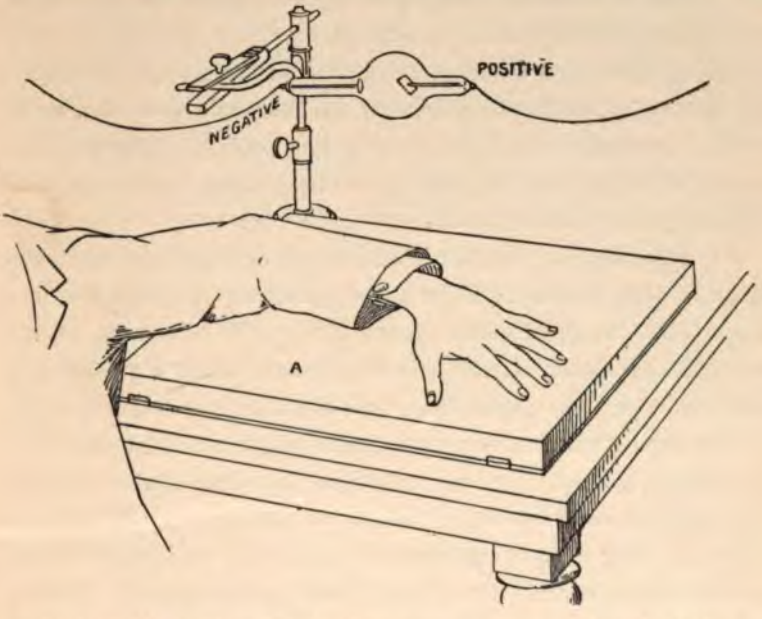
The advantages of great penetration, sharp definition, and wide radius of action are too obvious to require comment—for every one is seeking them—but one of the interesting side effects in my own experiments has been the observation of my own vertebræ, shoulder-joint, clavicle, ribs, and heart movement, as well as outlines of the skull bones through their covering. The shadows thus seen are distorted by the necessary position of the screen, and are by no means so clear as when witnessed by a second person who does not have to crane his neck to peer into the fluoroscope. A modified shape of this instrument could, however, easily be devised to enable every physician to either note his own anatomy or gratify others who might desire to do so.

In respect to photographic work, it is sufficient to say that by the aid of X rays that penetrate rapidly to long distances the object may be placed at more than ordinary distance from the tube if desired, and the familiar exposure time may be reduced. At sixteen and one-half inches I have secured the ribs of a man upon the negative in one and one-half minutes; but for a full and satisfactory picture of the trunk of the body, showing all the osseous detail, five minutes should be allowed, with the sensitive plate twenty or twenty-five inches from the reflector. The pelvis and knee have thicker bones, and exposure times for these must be governed by the result desired;

but any picture that formerly took thirty minutes with good apparatus can now be made in one-third of the time.

These capabilities indicate an efficiency which will prove helpful for rapid surgical examinations in all parts of the body.

One of the most practical matters which can concern the



Photographic position of the hand, arm, or any object which can be laid upon the plate-holder, *A*. The tube is adjusted from fifteen to twenty inches over the centre of the object, with the reflector turned downward. The connecting wires conform to the polarity of the machine.

operator in X-ray work is the question of getting a current through a tube when the resistance has become too high. We have long been able to increase the vacuum resistance satisfactorily when it has become considerably too low, provided the tube was correctly exhausted at the beginning.

Heat has usually been applied to the tube when the resistance has become too high. The upward tendency of the resistance is more rapid with coil and Leyden-jar currents than with

the static current direct from the prime conductors. The reason for this is doubtless the greater amperage of the former.

The tube can be carefully baked, either in a moderate oven with the door open, or by placing it upon the shelf above the range for fifteen or twenty minutes and allowing it to rest for several days. This sometimes gives a new lease of life to a tube which has been actively used until a current will no longer pass through it by ordinary methods.

The customary method of heating the tube consists in applying the flame of an alcohol lamp to the surface momentarily while the current is in action. The heat probably sets in motion the collected ions which polarize the electrodes, besides expanding the gases of the vacuum.

As, however, the current is got across the gap of high resistance in the circuit, not by the conducting properties of the atoms filling the interpolar space, but by the operation of the law that opposite electricities attract each other, we have evidently a means of stimulating the jump of the current if we increase the attracting forces. Large magnets will attract more than small magnets, and we can apply the same law to the terminals of a Crookes tube.

I have long been accustomed to assist the attraction of the current across the high-resisting space by holding the palm of my hand over the bulb between the cathode and the reflector. Observing the good effect of this and reasoning out the philosophy of its action, I have experimented with better conductors than the hand. While testing different methods I received a suggestion from Mr. Osterberg, the electrical engineer, who had previously been making similar experiments for a different purpose. The philosophy of the whole matter is now clear, and its practical utility is a decided assistance to the further use of a high-vacuum tube before sending it to the maker to be exhausted again.

The current from the opposite polarities is conducted up to the break in the circuit by fine wires, which may be compared

to very small electrical magnets. If we heat the tube we reduce the resistance a trifle, but we do little to increase the lines of attracting force. If, however, we multiply these lines several hundredfold by wrapping a layer of tinfoil around the terminals of the tube, beginning at the wires and extending over the arms of the tube until they begin to expand into the central bulb, we find, on starting the current into action, that the attraction of the opposite polarities is now sufficiently great to break down the barrier and establish the desired circuit. This method is much more effective than heat, but when the resistance gets beyond the capacity of these maximum attracting forces we can again resort to heat as an auxiliary aid. Finally, when the process becomes difficult and the result unsatisfactory, the tube can be exhausted again.

Despite the great amount of freshly awakened interest in all phases of the subject, the chief advance which is now taking place consists in spreading the already known facts before the general body of the profession. Things which were demonstrated six months and even a year ago are still new to thousands of physicians.

The matter of so-called X-ray burns, which was long ago relegated to the limbo of the earlier, low-efficiency, and discarded apparatus, has been brought out again and freshly discussed. Prof. Elihu Thomson, about two months ago, set out to give himself an X-ray burn. He put his finger within five-eighths of an inch of a tube prepared expressly to permit this close range. The above distance refers to the space between the operator's finger and the bombarded spot on the platinum anode, and does not mean five-eighths of an inch from the tube wall, which is often two or more inches from the point of bombardment. Over a portion of his finger he placed a layer of tinfoil, and at this extraordinarily small distance exposed the bare skin and the part covered with tinfoil to a powerful coil current for a length of time which Professor Thomson estimates would equal two entire days and nights—fifty hours—at ten

inches from the tube, according to the law governing X-ray intensity.

Now, any one who holds a layer of tinfoil against the fluoroscope will see that it is penetrated by X-rays about as easily as thin board. The rays get through it with scarcely a shadow; therefore the X rays reached the part of his finger which was covered by tinfoil. Under the tinfoil strip there was no action upon the skin, but on the rest of the skin a little dermatitis manifested itself on the ninth day. If this experiment does not demonstrate the fact that X rays do not burn, it is difficult to see how any fact can be conclusively demonstrated. The cause of the occasional dermatitis is some other influence than the X ray, and it is so easily avoided that it is not a matter of importance.

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